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ELEVENTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

STATE AGRICULTURAL EXPERIMENT STATION

AT

AMHERST, MASS.

1893.

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Commonwealth of Massachusetts.

Boston, Jan. 10, 1894.

To the Honorable Senate and House of Representatives.

In accordance with chapter 212 of the Acts of 1882 I have the honor to present the Eleventh Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,

Secretary.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

BOARD OF CONTROL, 1893.

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C. A. Goessmann, Ph.D., LL.D., *Director and Chemist*, . . Amherst.

J. B. Lindsey, Ph.D., *Associate Chemist (Feeding Department)*, . Amherst.

Assistants.

C. S. Crocker, B.S., .	*General and Analytical Chemistry.*
H. D. Haskins, B.S., .	" " "
C. H. Jones, B.S., . .	" " "
F. L. Arnold, B.S., .	" " "
C. H. Johnson, B.S., .	*Assistant Chemist and Feeding Department.*
E. B. Holland, B.S., .	" " " "
R. H. Smith, B.S., . .	*Assistant Chemist and Field Experiments.*
L. E. Goessmann, . .	*Assistant Chemist and Clerk.*
David Wentzell, . .	*Farmer.*

ELEVENTH ANNUAL REPORT OF THE DIRECTOR

OF THE

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN: — The work carried on at the State Agricultural Experiment Station during the past year compares favorably with that of the preceding year. The various lines of investigation presented for your consideration and indorsement at the different meetings of the Board have been followed up to the full extent of the resources at my disposal. The results obtained in some cases cannot fail to be of more than ordinary interest to the farmers of our State, while in others more time is needed for observation to draw reliable conclusions from the results thus far secured.

The recent additions and improvements in the outfit of the feeding department have aided materially in the investigation of more intricate questions of animal nutrition. The economical production of milk, beef, mutton, veal and pork has received serious attention. New concentrated feed stuffs, as well as coarse fodder articles raised upon the station grounds and new to our section of the country, have been practically tested, to ascertain their relative economical value as compared with current modes of feeding. The digestibility of various concentrated feed stuffs has been carefully tested by Dr. J. B. Lindsey in a series of trials with sheep. Experiments for ascertaining the relative economy of feeding skim-milk to young pigs and calves raised for the meat market have been instituted. A detailed account of these experiments will be found farther on under the following headings: —

Part I.

On Feeding Experiments.

I. Feeding experiments with milch cows (two).

1. General feeding experiments with milch cows: —
   Grain feed: Buffalo gluten feed, wheat bran and cotton-seed meal.
   Coarse feed: English hay, corn stover, and corn and soja-bean ensilage.
2. Summer feeding experiments with milch cows: —
   Grain feed: Buffalo gluten feed, new-process linseed meal, wheat bran and cotton-seed meal.
   Coarse feed: rowen, green fodder corn and green vetch and oats.
3. Creamery record of the station for 1892 and 1893.

II. Feeding experiments with steers.
III. Feeding experiments with lambs.
IV. Feeding experiments with pigs (two).
V. Feeding experiments with calves.
VI. Digestion experiments with sheep.
VII. Feeding experiments with horses.

The past season was not quite as favorable for the conducting of field experiments as some preceding years have been. A serious drought at the close of the growing period affected the results in a number of cases. Many of the results obtained may, however, be considered satisfactory. The following lines of investigation have been carried on in the field.

Part II.

On Field Experiments.

1. Field experiments to ascertain the effect of the exclusion of every form of nitrogen-containing manurial matter from the fertilizer applied for the production of a grain crop (oats) on its yield per acre (Field A).
2. Field experiments with prominent varieties of grasses and grass mixtures under fairly corresponding circumstances and with different varieties on potatoes (Field B).
3. Field experiments regarding the effect of different combinations of commercial fertilizers on the yield of some prominent garden crops (Field C).
4. Observations regarding the adaptation of a variety of more or less reputed fodder plants new to our section of the country (Field D).

5. Field experiments with different commercial phosphates, to study the economy of using the cheaper natural phosphates or the more costly acidulated phosphates (Field F).
6. Field experiments to show the effect of barn-yard manure on the yield of corn (Field G).
7. Field experiments to determine the effect of various fertilizer mixtures on leguminous and grain crops (East Field).
8. Observations on permanent grass lands, — meadows.
9. Report on general farm work.
10. On special fertilization with reference to some prominent industrial crops, fruits and garden vegetables.

The recently increased facilities for chemical analysis have been tested to their full capacity, as may be seen from the following enumeration of examinations called for: —

Fertilizers, official,	214
Fertilizers, sent on,	50
Fertilizers, for station,	24
Fodders, sent on,	32
Fodders, for station,	31
Wood ashes,	108
Milk, for station,	295
Milk, sent on,	26
Cream,	46
Skim-milk,	24
Buttermilk,	8
Water,	93
Miscellaneous,	32

The entire work carried on in the chemical department will be found in subsequent pages under the following heads: —

PART III.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

I. Communication on commercial fertilizers: —

1. General introduction.
2. State laws for the regulation of the trade in commercial fertilizers.
3. List of licensed manufacturers and dealers from May 1, 1893, to May 1, 1894 (52).
4. Analyses of licensed fertilizers (214).
5. Analyses of commercial fertilizers and manurial substances sent on for examination (169).
6. Miscellaneous analyses (7).
7. Miscellaneous fodder analyses (45).

II. Analyses of milk sent on for examination (26).
III. Analyses of water sent on for examination (93).
IV. Compilation of analyses made at Amherst, Mass., of agricultural chemicals and refuse materials used for fertilizing purposes.
V. Compilation of analyses made at Amherst, Mass., of fodder articles, fruits, sugar-producing plants, dairy products, etc.
VI. Table of the digestibility of American feed stuffs.

The meteorological observations for local purposes have been continued, and the results reported to the authorities in Boston and Washington. The periodical publications of the work accomplished at the station have been continued, seven bulletins having been issued during the year, treating mainly of analyses of fertilizers, feed stuffs, etc. The interest in these publications has manifested itself by a steady increase of applications from within the State as well as other parts of the country.

The general condition of some of the buildings of the experiment station is such that in the interest of good economy serious attention for more extensive repairs seems advisable at this time. As the existing financial resources do not warrant the expenditures in that direction, I recommend the application for suitable appropriation by the State Legislature to meet these wants.

I feel it my pleasant duty to express to you my particular satisfaction for the assistance I have received from all parties engaged with me in the work accomplished during the past year. Thanking you for your kind support in the performance of the duties assigned me, I am,

Yours very respectfully,

C. A. GOESSMANN,

Director of the Massachusetts State Agricultural Experiment Station.

PART I.

FEEDING EXPERIMENTS.

BY J. B. LINDSEY.

I. Feeding Experiments with Milch Cows (two).
II. Feeding Experiments with Steers.
III. Feeding Experiments with Lambs.
IV. Feeding Experiments with Pigs (two).
V. Feeding Experiments with Calves.
VI. Digestion Experiments with Sheep.
VII. Feeding Experiments with Horses.

General Introduction.

The feeding experiments described in this report have been conducted with a view to answering many of the practical questions asked by the farmers of Massachusetts. Several of them are a continuation of those published in previous reports, while others have been started to answer questions of importance to the farming community. They are divided as follows: —

I. Feeding Experiments with Milch Cows.

The principal objects of these experiments have been: —

1. To ascertain the comparative value of different kinds of *coarse fodders* upon the economical production of milk and cream.

2. To notice the effects of these foods, if any, upon the composition of the milk and cream.

Many other facts are also brought out in the experiment, as, for example, the number of quarts of milk required to produce a space of cream, etc.

The general object of all the experiments with milch cows has been to find those methods of feeding best suited to produce milk and cream at the minimum cost, and to do this by raising a greater variety of coarse fodder articles upon the farm, and supplementing these fodders with concentrated feed stuffs.

II. Feeding Experiments with Steers.

These experiments have been in progress for several years, with these objects in view: —

1. To ascertain those fodder rations that would produce the greatest growth for the least outlay of money.

2. To find out what it actually costs to produce beef in Massachusetts.

3. To compare the relative merits of soiling *vs.* pasture for growing stock during the summer months.

III. Feeding Experiments with Lambs (Winter).

The objects sought have been: —

1. To find the cost of producing live weight under a rational system of feeding.

2. To find out if ensilage could be substituted to a considerable extent for rowen in the coarse fodder rations.

IV. Feeding Experiments with Pigs.

Objects: —

1. To ascertain the value of Buffalo gluten feed and corn meal when fed in connection with skim-milk.

2. The cost of producing pork.

V. Feeding Experiments with Calves.

Objects: —

1. To ascertain whether it is more profitable to feed skim-milk to growing calves or to pigs.

2. To find the rate of growth when calves are fed on skim-milk alone, and when fed on skim-milk and grain.

In all the five experiments thus far mentioned, especial attention is called to the value of the manure produced in connection with a rational system of general farm management. Upon the character of the food fed depends not only the quantity of milk, beef, pork or mutton produced, but also the value of the manure obtained.

VI. Digestion Experiments with Sheep.

The object of these experiments has been to inquire into the digestibility of English mixed hay and of the new con-

centrated feed stuffs, such as Buffalo gluten feed, the new and old process linseed meals, etc.

VII. Feeding Experiments with Horses.

This section contains facts in relation to the feeding of four horses at the station during several years past (1888-93).

Farmers are especially requested to address the station if questions arise relating to the experiments herein described, or if any information is desired concerning any problem in stock feeding. Any information at the command of the station will be cheerfully given.

J. B. LINDSEY.

I.

FEEDING EXPERIMENTS WITH MILCH COWS (TWO).

1. General Feeding Experiments with Milch Cows.

October, 1892, to July, 1893.

[Grain feed: Buffalo gluten feed, wheat bran and cotton-seed meal; coarse feed: English hay, corn stover and corn and soja-bean ensilage.]

Objects of the Experiment.

1. To study the comparative feeding effects of English hay, corn stover and corn and soja-bean ensilage upon the cost, quantity and quality of the milk produced.

2. The comparative feeding value of rowen *vs.* hay of peas and oats.

Attention is also called to the value of the manurial ingredients in the feed consumed, and to the value of the manure produced by the different rations fed; also the quality of the milk produced during the different feeding periods.

History of Cows.

NAME OF COW.	BREED.	Age (Years).	LAST CALF DROPPED.	Daily Yield of Milk at Beginning of Trial (Quarts).	Number of Months on Trial.
May, . .	Native, ...	6-7	Jan. 15, 1892,	6–7	9
Gem, . .	Grade Shorthorn, .	5	Dec. 6, 1891,	11–12	10
Lucy, . .	Grade Ayrshire, .	6	June 2, 1891,	8–9	17
Florence, .	Grade Shorthorn, .	7	May 13, 1892,	10–11	5
Viola, . .	Native, ...	(?)	Feb. 10, 1892,	5–6	7
Anna, . .	Native, ...	(?)	Jan. 26, 1892,	5–6	8
Stella, . .	Grade Durham, .	11	Jan. 5, 1893,	16–17	–
Jennie, .	Grade Jersey, . .	4	Dec. 25, 1892,	10–11	–
Julia, . .	Native, ...	9	Jan. 18, 1893,	12–13	–
Nora, . .	Grade Ayrshire, .	5	Mar. 25, 1893,	–	–

As will be seen from the above record, these cows are grades of various descriptions and of different milking periods. They probably represent average cows of the various herds kept by farmers in this section of the State.

It will be observed that only two of the cows, viz., Gem and Florence, were retained during the entire experiment, several having been dropped, owing to a too advanced stage of milking, and new milch cows put in their places. The records of all the cows on trial are, however, presented, as they furnish data from which to judge of the comparative feeding effects of the several varieties of fodder.

Description of Fodder Articles.

The grain feed remained constant throughout the entire experiment, and consisted of Buffalo gluten feed, wheat bran and cotton-seed meal. The chemical and mechanical condition was good.

The coarse feed consisted of good hay of mixed grasses, rowen (second cut of grass lands), well-cured hay of peas and oats, corn stover, corn and soja-bean ensilage and globe mangolds.

The ensilage was made from "Pride of the North" corn and a late variety of soja bean, cut up into pieces several inches in length. The corn was cut for ensilage when the kernels had begun to glaze. The soja bean was a late variety which failed to blossom. When cut it measured three and one-half feet in height.

Silo No. 1 contained equal weight parts of corn and soja bean, while silo No. 2 contained two parts of soja bean to one part of corn. These ensilages are called respectively corn and soja-bean ensilage and soja-bean and corn ensilage. The silos were filled rapidly, and treated as described in previous reports. Silo No. 1 was much larger, and contained several times as much ensilage as No. 2.

The corn stover was obtained from the same variety of corn as that put into the silo, and is the field-cured plant remaining after the fully matured ears have been removed. It was cut into short lengths before being fed. The hay of peas and oats was the portion that remained over from the summer green feeding, and was cut when in late blossom and dried.

The following tables contain the analyses of the various grains and coarse fodders, together with their fertilizing value obtainable after they have passed through the animal, *i. e.*, in the manure.

Analyses of Fine Feed used.

FODDER ANALYSES.	Wheat Bran.	Buffalo Gluten Feed.	Cotton-seed Meal.
Moisture at 100° C.,	10.35	8.28	7.00
Dry matter,	89.65	91.72	93.00
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	7.39	0.91	7.45
" cellulose,	11.60	7.78	6.63
" fat,	5.72	13.61	12.20
" protein,	17.78	26.03	44.33
Non-nitrogenous extract matter,	57.51	51.67	29.39
	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Wheat Bran.	Buffalo Gluten Feed.	Cotton-seed Meal.
Moisture,	10.35	8.28	7.00
Nitrogen,	2.45	3.82	6.59
Phosphoric acid,	2.85	0.46	2.33
Potassium oxide,	1.63	0.10	1.72
Valuation per 2,000 pounds,	$11 95	$12 06	$23 88
Manurial value obtainable,	9 56	9 65	19 10

Analyses of Coarse Fodder Articles used.

Fodder Analyses.	Hay.	Rowen.	Hay of Peas and Oats.	Corn Stover.	Corn and Soja-bean Ensilage.*	Soja-bean and Corn Ensilage.†	Globe Mangolds.
Moisture at 100° C.,	9.00	11.31	12.30	14.66	77 77	80.33	88.51
Dry matter,	91.00	88.69	87.70	85.34	22.23	19.67	11.49
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.							
Crude ash,	6.64	6.48	6.90	5.49	9.48	11.91	12.88
" cellulose,	34.82	29.98	26.66	37.57	26.63	29.00	9.98
" fat,	3.18	4.23	2.29	1.82	3.75	3.02	1.14
" protein,	10.41	12.11	16.01	4.00	7.91	8.41	7.04
Non-nitrogenous extract matter,	44 95	47.20	48.14	51.12	52 23	47.66	68.96
	100.00	100.00	100.00	100.00	100.00	100 00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

Fertilizer Analyses.	Hay.	Rowen.	Hay of Peas and Oats.	Corn Stover.	Corn and Soja-bean Ensilage.*	Soja-bean and Corn Ensilage.†	Globe Mangolds.
Moisture,	9.00	11.30	12.30	14.66	77.77	80.33	88.51
Nitrogen,	1.52	1.72	2.24	0.55	0.32	0.27	0.13
Phosphoric acid,	0.35	0.46	0.65	0.23	0.12	0.12	0.10
Potassium oxide,	1.54	1.97	2.10	1.84	0.48	0.48	0.47
Valuation per 2,000 pounds,	$6 32	$6 56	$9 32	$3 55	$1 52	$1 37	$0 92
Manurial value obtainable,	5 06	5 25	7 46	2 84	1 22	1 10	0 74

* Equal parts by weight. † Two parts soja bean to one part corn.

Mode of Feeding.

The entire experiment is divided into two parts: Part 1 includes hay, hay and roots, corn stover, "corn and soja-bean ensilage," and "soja-bean and corn ensilage." It covers nearly eight months. The feeding periods vary in length from several weeks to several months in case of the corn and soja-bean ensilage. Part 2 has only two feeding periods, and extends over but one month of time.

The grain ration remained constant during the entire experiment, and consisted of three pounds each of wheat bran, Buffalo gluten feed and cotton-seed meal. One-half the grain was fed at the time of milking in the morning, together with one-half of the coarse fodder; and the other half, together with the remainder of the coarse fodder, at the time of milking in the afternoon, about five o'clock.

The animals were watered twice each day, about two hours after feeding.

The amount of coarse fodder fed depended upon the individual appetite of the different animals. Hay constituted the entire coarse feed in the first feeding period, and amounted to fifteen pounds per day. In the second period fifteen pounds of globe mangolds were added. The corn stover consumed in the third period amounted to from twelve to fourteen pounds daily. When first fed the animals consumed somewhat more, but the amount gradually decreased to twelve to fourteen pounds, which can be regarded as the average daily consumption. During the fourth and fifth periods the hay feed was limited to four pounds daily, while the ensilage was fed *ad libitum*. This generally amounted to from forty to sixty pounds per day, with fifty pounds as a fair average. During the sixth period the hay of peas and oats consumed varied from fourteen to sixteen pounds daily, and the rowen in the seventh period, from sixteen to eighteen pounds per day.

For more details see the record of each cow.

Local Market Cost, per Ton, of the Various Articles of Fodder.

Wheat bran,	$19 00
Buffalo gluten feed,	20 00
Cotton-seed meal,	28 00
Hay,	15 00
Rowen,	15 00
Hay of peas and oats,	15 00
Corn stover,	5 00
Corn and soja-bean ensilage,	2 75
Soja-bean and corn ensilage,	2 75
Globe mangolds,	4 00

The commercial value of the various fodder rations about to be described is based upon the above-stated market cost.

Average Composition of the Daily Fodder Rations used during the Seven Successive Feeding Periods (1892–1893).

3 pounds wheat bran equal 4 quarts.
3 pounds Buffalo gluten feed equal 3 quarts.
3 pounds cotton-seed meal equal 2 quarts.

I.

October 18 to November 9.

Wheat bran,	3 lbs.
Buffalo gluten feed,	3 "
Cotton-seed meal,	3 "
Hay,	15 "
Nutritive ratio,	1:4.5
Total cost,	21.3 cts.
Manurial value obtainable,	9.54 "
Net cost,	11.76 "

II.

November 14 to December 3.

Wheat bran,	3 lbs.
Buffalo gluten feed,	3 "
Cotton-seed meal,	3 "
Hay,	15 "
Globe mangolds,	15 "
Nutritive ratio,	1:4.9
Total cost,	24.3 cts.
Manurial value obtainable,	10.10 "
Net cost,	14.20 "

III.

December 12 to January 9.

Wheat bran,	3 lbs.
Buffalo gluten feed,	3 "
Cotton-seed meal,	3 "
Corn stover,	15 "
Nutritive ratio,	1:4.8
Total cost,	13.85 cts.
Manurial value obtainable,	7.88 "
Net cost,	5.97 "

IV.

January 18 to April 4.

Wheat bran,	3 lbs.
Buffalo gluten feed,	3 "
Cotton-seed meal,	3 "
Hay,	4 "
Corn and soja-bean ensilage,	50 "
Nutritive ratio,	1:4.9
Total cost,	19.90 cts.
Manurial value obtainable,	9.81 "
Net cost,	10.09 "

V.

May 11 to May 26.

Wheat bran,	3 lbs.
Buffalo gluten feed,	3 "
Cotton-seed meal,	3 "
Hay,	4 "
Soja-bean and corn ensilage,	50 "
Nutritive ratio,	1:4.8
Total cost,	19.90 cts.
Manurial value obtainable,	9.51 "
Net cost,	10.39 "

VI.

June 8 to June 21.

Wheat bran,	3 lbs.
Buffalo gluten feed,	3 "
Cotton-seed meal,	3 "
Hay of peas and oats,	16 "
Nutritive ratio,	1:3.77
Total cost,	22.05 cts.
Manurial value obtainable,	10.36 "
Net cost,	11.69 "

Average Composition of the Daily Fodder Rations — Concluded.

VII.

June 27 to July 6.

Wheat bran,	3 lbs.
Buffalo gluten feed,	3 "
Cotton-seed meal,	3 "
Rowen,	18 "
Nutritive ratio,	1:4.51.
Total cost,	23.55 cts.
Manurial value obtainable,	10.48 "
Net cost,	13.07 "

Summary of Cost of the Average Daily Fodder Rations.

[Cents.]

	Total Cost.	Manurial Value Obtainable.	Net Cost.
I. Grain and hay,	21.30	9.54	11.76
II. Grain, hay and mangolds,	24.30	10.10	14.20
III. Grain and corn stover,	13.85	7.88	5.97
IV. Grain, hay and ensilage,	19.90	9.81	10.09
V. Grain, hay and ensilage,	19.90	9.51	10.39
VI. Grain and hay of peas and oats,	22.05	10.36	11.69
VII. Grain and rowen,	23.55	10.48	13.07

The *total cost* of a fodder ration is the sum of the market costs of the different articles consumed per day. The *manurial value obtainable* is the value of the nitrogen, phosphoric acid and potash of the ration fed that will be found in the manure. In case of milch cows this amounts on an average to 80 per cent. of the fertilizing ingredients contained in the feed. The other 20 per cent. goes into the milk or flesh of the animal. The value of the nitrogen, phosphoric acid and potash thus excreted is based upon the retail

cost of these articles in the open markets. When the experiment was in operation this amounted to 15 cents per pound for nitrogen, 5½ cents per pound for phosphoric acid and 4½ cents per pound for potash. The *net cost* of a ration is that cost remaining after the value of the manure has been deducted from the total cost. It is to be observed that the value of the manure, *i.e.*, its content of nitrogen, phosphoric acid and potash, depends entirely upon the character of the fodder articles fed. Thus, if the feed consists of corn meal and hay, each of which articles have an obtainable manurial value of about $5 per ton, the value of the manure will be considerably inferior to one where cotton-seed meal with an obtainable manurial value of about $20 per ton or wheat bran with an obtainable manurial value of $10 per ton are fed.

All the concentrated feed stuffs, such as linseed meal, cotton-seed meal, gluten meal, gluten feed and wheat bran, have a very high percentage of nitrogen, which greatly increases the value of the manure produced by the animal.

Quantity and Cost of Milk produced per Day.

FEEDING PERIODS.	MAY.		GEM.		LUCY.		VIOLA.		ANNA.	
	Quantity Daily.	Cost per Quart.	Quantity Daily.	Cost per Quart.	Quantity Daily.	Cost per Quart.	Quantity Daily.	Cost per Quart.	Quantity Daily.	Cost per Quart.
	Qts.	Cts.	Qts.	Cts.	Qts.	Cts.	Qts.	Cts.	Qts.	Cts.
Part 1.										
I. Grain and hay, . . .	6.34	3.36	11.24	1.89	8.45	2.52	5.82	3.65	5.80	3.67
II. Grain, hay and mangolds,	6.47	3.76	11.93	2.04	8.84	2.75	5.23	4.61	5.72	*3.60
III. Grain and corn stover, .	4.94	2.71	9.26	1.45	6.69	1.95	3.74	3.78	4.75	2.73
IV. Grain, hay and ensilage, .	–	–	12.21	1.55	7.30	2.27	–	–	–	–
V. Grain, hay and ensilage, .	–	–	11.77	1.71	–	–	–	–	–	–
Part 2.										
VI. Grain and peas and oats,	–	–	10.32	2.04	–	–	–	–	–	–
VII. Grain and rowen, . .	–	–	11.03	2.07	–	–	–	–	–	–
Average, ...	5.92	3.28	11.11	1.82	7.82	2.37	4.98	4.01	5.42	3.33

* Cow consumed five pounds less hay per day during this period.

Quantity and Cost of Milk produced per Day — Continued.

FEEDING PERIODS.	FLORENCE.		JULIA.		JENNIE.		NORA.	
	Quantity Daily.	Cost per Quart.	Quantity Daily.	Cost per Quart.	Quantity Daily.	Cost per Quart.	Quantity Daily.	Cost per Quart.
	Qts.	Cts.	Qts.	Cts.	Qts.	Cts.	Qts.	Cts.
Part 1.								
I. Grain and hay, . . .	10.46	2.04	-	-	-	-	-	-
II. Grain, hay and mangolds, .	10.58	2.29	-	-	-	-	-	-
III. Grain and corn stover, .	7.12	1.87	-	-	-	-	-	-
IV. Grain, hay and ensilage, .	9.31	2.14	12.85	1.52	10.86	1.72	-	-
V. Grain, hay and ensilage, .	8.24	2.43	11.50	1.73	9.50	2.02	11.45	1.73
Part 2.								
VI. Grain and peas and oats, .	7.20	3.00	-	-	8.70	2.42	10.48	1.94
VII. Grain and rowen, . .	7.52	3.13	9.30	2.37	8.19	2.58	10.60	2.08
Average, ...	8.63	2.41	11.22	1.87	9.31	2.18	10.84	1.92

Comments on the Above Results.

Remembering that during the entire experiment the grain ration remained the same, and that the quantity of coarse fodders fed was in all cases governed by the individual appetite of the animal, the following points are worthy of notice: —

1. That when the roots were added to the hay ration the flow of milk in four cases out of six increased, in one case remained constant and in one case slightly decreased. The increased yield, however, was not sufficient to pay for the extra cost of the roots, and the total cost of the milk per quart was noticeably increased in this period.

2. The grain and hay ration produced a comparatively fair yield, but the average cost of production per quart in the case of three cows whose record extends through the three periods was above that for the corn stover and corn and soja-bean ensilage rations. The cost per quart when hay was fed as the coarse fodder was 2.15 cents, with corn stover but 1.76 cents and with ensilage 1.99 cents.

3. The yield of milk decreased on an average 25 per cent. during the corn-stover period; but because of the low

market value of this fodder the average cost of producing one quart of milk, in case of three cows, was lowest in this period, namely, 1.76 cents.

4. In feeding period IV. (corn and soja-bean ensilage), where cows Gem, Lucy and Florence are considered, it will be observed that the ensilage caused a marked increase in the yield of milk from Gem, and not a very great decrease in the case of the other two cows. These results, together with the fact that the period lasted seventy-five days, during which time the cows would naturally shrink some in their yield, indicates that the corn and soja-bean ensilage was instrumental in stimulating the flow of milk. This period produced milk, in case of five cows whose average yield was 10.5 quarts per day, at 1.84 cents per quart, which may be considered fairly low.

5. In comparing the merits of rowen and the hay of peas and oats, it will be observed that there is no great difference in the results. The yield of milk was slightly increased by the rowen over the peas and oats, but rather more rowen was consumed, making the cost per quart of milk a trifle higher. It can be stated, however, that hay of well-cured peas and oats compares very favorably with a good quality of rowen for milk production.

6. That the cost of milk per quart depends upon the absolute yield is also worthy of notice. It is noticeable that when the cows yield but 4 to 5 quarts of milk per day the total cost of this milk is 3½ to 4 cents per quart; and when 6 quarts are produced the cost is about 3 cents per quart. This fact has been previously emphasized in the reports of the station, namely, that a cow ceases to be profitable when she yields but 6 quarts or less per day. If the farmer, therefore, would make milk production profitable it is of the utmost importance that he should select cows that are capable of giving large and continuous yields of milk. A herd of cows in which the average yield is but 7 to 8 quarts cannot be a very profitable one.

Quality of Milk produced.

Feeding Periods.	Rations	May. Total Solids.	May. Fat.	Gem. Total Solids.	Gem. Fat.	Lucy. Total Solids.	Lucy. Fat.	Viola. Total Solids.	Viola. Fat.	Anna. Total Solids.	Anna. Fat.	Florence. Total Solids.	Florence. Fat.	Jennie. Total Solids.	Jennie. Fat.	Julia. Total Solids.	Julia. Fat.	Nora. Total Solids.	Nora. Fat.
	Part 1.																		
I. 22 days.	Grain and hay,	14.00	3.50	13.76	3.90	14.57	4.05	13.89	3.90	11.76	2.70	14.24	4.65	-	-	-	-	-	-
	Grain and hay,	13.72	3.60	13.50	4.05	13.27	4.20	14.80	3.80	12.03	2.60	14.22	4.25	-	-	-	-	-	-
	Average,	**13.86**	**3.55**	**13.63**	**3.97**	**13.92**	**4.12**	**14.34**	**3.85**	**11.90**	**2.65**	**14.23**	**4.45**	-	-	-	-	-	-
II. 19 days.	Grain, hay and mangolds,	13.16	3.40	13.82	4.40	13.33	4.60	13.68	4.20	12.22	2.80	13.72	4.40	-	-	-	-	-	-
	Grain, hay and mangolds,	13.27	3.40	13.03	4.60	14.37	4.60	14.08	4.20	11.23	2.80	14.14	4.40	-	-	-	-	-	-
	Average,	**13.21**	**3.40**	**13.41**	**4.50**	**13.85**	**4.60**	**13.88**	**4.20**	**11.72**	**2.80**	**13.93**	**4.40**	-	-	-	-	-	-
III. 28 days.	Grain and corn stover,	14.02	4.80	13.47	4.00	14.27	5.00	14.38	4.20	11.73	3.00	14.13	5.00	-	-	-	-	-	-
	Grain and corn stover,	-	-	14.06	4.00	14.55	5.40	-	-	-	-	14.37	5.10	14.13	4.40	-	-	-	-
	Average,	**14.02**	**4.80**	**13.76**	**4.00**	**14.41**	**5.20**	**14.38**	**4.20**	**11.73**	**3.00**	**14.25**	**5.05**	**14.13**	**4.40**	-	-	-	-
IV. 86 days.	Grain, hay, and corn and soja-bean ensilage,	-	-	12.42	3.66	-	-	-	-	-	-	13.97	4.36	-	-	-	-	-	-
	Grain, hay, and corn and soja-bean ensilage,	-	-	13.14	4.22	-	-	-	-	-	-	13.31	4.42	-	-	-	-	-	-
	Grain, hay, and corn and soja-bean ensilage,	-	-	13.48	4.26	-	-	-	-	-	-	13.84	-	-	-	-	-	-	-
	Grain, hay, and corn and soja-bean ensilage,	-	-	12.96	4.30	-	-	-	-	-	-	13.81	4.62	-	-	-	-	-	-
	Grain, hay, and corn and soja-bean ensilage,	-	-	12.93	4.30	-	-	-	-	-	-	13.08	4.67	-	-	-	-	-	-
	Grain, hay, and corn and soja bean ensilage,	-	-	14.36	5.13	14.14	4.88	-	-	-	-	13.36	4.18	14.42	3.93	14.02	5.38	-	-
	Grain, hay, and corn and soja-bean ensilage,	-	-	13.09	4.06	14.05	4.90	-	-	-	-	13.83	4.22	14.35	5.20	14.58	5.26	-	-

Quality of Milk produced — Concluded.

Feeding Periods.	Rations.	May. Total Solids.	May. Fat.	Gem. Total Solids.	Gem. Fat.	Lucy. Total Solids.	Lucy. Fat.	Viola. Total Solids.	Viola. Fat.	Anna. Total Solids.	Anna. Fat.	Florence. Total Solids.	Florence. Fat.	Jennie. Total Solids.	Jennie. Fat.	Julia. Total Solids.	Julia. Fat.	Nora. Total Solids.	Nora. Fat.
IV. 86 days.	Grain, hay, and corn and soja-bean ensilage,	-	-	13.33	4.19	14.03	4.89	-	-	-	-	14.24	4.68	14.22	5.18	14.48	5.27	-	-
	Grain, hay, and corn and soja-bean ensilage,	-	-	13.72	4.76	14.25	4.88	-	-	-	-	14.14	4.82	14.43	5.27	14.04	4.86	-	-
	Grain, hay, and corn and soja bean ensilage,	-	-	13.13	3.99	-	-	-	-	-	-	14.09	4.80	14.29	5.05	13.84	4.71	-	-
	Grain, hay, and corn and soja-bean ensilage,	-	-	12.91	4.33	-	-	-	-	-	-	14.24	4.86	-	-	14.59	5.29	-	-
	Average,	-	-	**13.22**	**4.72**	**14.12**	**4.89**	-	-	-	-	**13.99**	**4.56**	**14.34**	**4.92**	**14.26**	**5.13**	-	-
V. 25 days.	Grain, hay, and soja-bean and corn ensilage,	-	-	13.09	4.08	-	-	-	-	-	-	13.82	4.52	14.63	5.33	13.85	4.75	13.49	3.99
	Grain, hay, and soja-bean and corn ensilage,	-	-	13.13	4.05	-	-	-	-	-	-	-	-	14.68	5.41	13.76	4.70	13.86	4.23
	Grain, hay, and soja-bean and corn ensilage,	-	-	13.38	4.31	-	-	-	-	-	-	13.50	4.34	14.20	5.39	13.84	4.69	13.59	3.86
	Grain, hay, and soja-bean and corn ensilage,	-	-	13.17	3.77	-	-	-	-	-	-	13.50	4.21	14.38	5.09	13.32	4.75	13.97	4.34
	Average,	-	-	**13.19**	**4.05**	-	-	-	-	-	-	**13.61**	**4.36**	**14.47**	**5.21**	**13.69**	**4.72**	**13.73**	**4.11**
	Part 2.																		
VI. 14 days.	Grain and hay of peas and oats,	-	-	13.29	4.10	-	-	-	-	-	-	13.81	4.20	14.64	5.11	-	-	13.50	4.41
	Grain and hay of peas and oats,	-	-	13.61	3.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Average,	-	-	**13.45**	**4.10**	-	-	-	-	-	-	**13.81**	**4.20**	**14.64**	**5.11**	-	-	**13.50**	**4.41**
VII. 9 days.	Grain and rowen,	-	-	12.87	3.91	-	-	-	-	-	-	13.91	4.54	14.85	5.27	13.83	4.67	12.83	3.44
	Grain and rowen,	-	-	13.09	4.09	-	-	-	-	-	-	13.85	4.51	13.96	4.25	13.78	4.39	12.86	4.18
	Average,	-	-	**12.98**	**4.00**	-	-	-	-	-	-	**13.88**	**4.52**	**14.41**	**4.76**	**13.81**	**4.53**	**12.85**	**3.81**

At the beginning of the experiment, samples of the milk were taken daily, but it was finally decided to make a composite sample of three days' milk (Monday, Tuesday and Wednesday) of each week, believing that in this way a better knowledge of the composition of the milk produced by the various cows could be obtained.

Did the Coarse Fodders Influence the Quality of the Milk?

By the quality of the milk the percentages of total solids and of fat are referred to. A close study of the analyses of the milk in the various periods leads to the conclusion that the different coarse fodders exerted no decided influence upon the composition of the milk. There were variations from week to week, both in the percentage of total solids and of fat, but no marked change is noticed in any one particular period, and the slight variations that do occur should without doubt be attributed to the condition of the animal, and the consequent influence upon the secretion, rather than to any particular influence due to the feed consumed.

General Conclusions.

This experiment confirms others made at the station, and points out the economy of raising and feeding a greater variety of coarse fodder articles, substituting them for the high-priced hay.

Corn and soja-bean ensilage has proved itself to be fully equal if not superior to hay in producing a yield of milk, without affecting the quality and at the same time decreasing the absolute cost. This ration produced milk at less than two cents per quart.

Roots, while they are beneficial to the health of the animals, especially those fed upon dry fodder, cannot be fed to any extent economically, because of the increased cost of the milk produced.

Hay of peas and oats proved itself to be nearly or quite equal to a good quality of rowen for milk production.

The different coarse fodders have not influenced the composition of the milk to any noticeable extent.

FEEDING RECORD.

May.

Feeding Periods	Feed consumed (Pounds) per Day.						Dry Matter consumed per Day (Pounds).	Milk produced per Day (Quarts).	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Buffalo Gluten Feed.	Cotton-seed Meal.	Hay.	Corn Stover.	Mangolds.					
1892-93.											
Oct. 18 to Nov. 9,	3.00	3.00	3.00	15.00	–	–	21.88	6.34	3.45	1:4.5	982
Nov. 14 to Dec. 3,	3.00	3.00	3.00	15.00	–	15.00	23.60	6.47	3.65	1:4.9	992
Dec. 12 to Jan. 9,	3.00	3.00	3.00	–	13.43	–	19.69	4.93	3.99	1:4.6	1,023

Viola.

Oct. 18 to Nov. 9,	3.00	3.00	3.00	15.00	–	–	21.88	5.83	3.75	1:4.5	965
Nov. 14 to Dec. 3,	3.00	3.00	3.00	14.73	–	15.00	23.35	5.23	4.46	1:4.9	994
Dec. 12 to Jan. 4,	3.00	3.00	3.00	–	16.61	–	22.40	3.74	5.99	1:4.9	983

Anna.

Oct. 18 to Nov. 9,	3.00	3.00	3.00	15.00	–	–	21.88	5.80	3.77	1:4.5	1,010
Nov. 14 to Dec. 3,	3.00	3.00	3.00	10.21	–	15.00	19.24	5.70	3.38	1:4.4	1,040
Dec. 12 to Jan 4,	3.00	3.00	3.00	–	11.78	–	18.28	4.75	3.85	1:4.55	1,027

FEEDING RECORD — *Continued.*

Gem.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.										Dry Matter consumed per Day (Pounds).	Milk produced per Day (Quarts).	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Buffalo Gluten Feed.	Cotton-seed Meal.	Hay.	Rowen.	Corn Stover.	Hay of Peas and Oats.	Corn and Soja-bean Ensilage.	Soja-bean and Corn Ensilage.	Mangolds.					
1892-93.															
Oct. 18 to Nov. 9,	3.00	3.00	3.00	15.00	–	–	–	–	–	–	21.88	11.11	1.97	1:4.5	936
Nov. 14 to Dec. 3,	3.00	3.00	3.00	15.00	–	–	–	–	–	15.00	23.60	11.93	1.98	1:4.9	961
Dec. 12 to Jan. 10,	3.00	3.00	3.00	–	–	13.34	–	–	–	–	19.61	9.26	2.12	1:4.6	929
Jan. 18 to April 4,	2.94	2.94	2.94	4.00	–	–	–	43.22	–	–	22.31	12.21	1.83	1:4.8	941
May 1 to May 26,	2.88	2.88	2.88	4.00	–	–	–	–	51.72	–	21.72	11.76	1.85	1:4.9	967
June 8 to June 22,	3.00	3.00	3.00	–	–	–	14.71	–	–	–	21.13	10.32	2.05	1:3.6	1,012
June 27 to July 6,	3.00	3.00	3.00	–	17.11	–	–	–	–	–	23.40	11.03	2.12	1:4.45	1,002

Lucy.

FEEDING PERIODS.	Wheat Bran.	Buffalo Gluten Feed.	Cotton-seed Meal.	Hay.	Rowen.	Corn Stover.	Hay of Peas and Oats.	Corn and Soja-bean Ensilage.	Soja-bean and Corn Ensilage.	Mangolds.	Dry Matter consumed per Day (Pounds).	Milk produced per Day (Quarts).	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
Oct. 18 to Nov. 9,	3.00	3.00	3.00	15.00	–	–	–	–	–	–	21.88	8.45	2.59	1:4.5	877
Nov. 14 to Dec. 3,	3.00	3.00	3.00	15.00	–	–	–	–	–	15.00	23.60	8.84	2.67	1:4.9	888
Dec. 12 to Jan. 10,	3.00	3.00	3.00	–	–	12.31	–	–	–	–	18.74	6.69	2.80	1:4.5	869
Feb. 18 to Mar. 15,	3.00	3.00	3.00	4.00	–	–	–	25.84	–	–	17.61	7.30	2.41	1:4.0	865

FEEDING RECORD — *Continued.*

Florence.

Feeding Periods.	Feed consumed (Pounds) per Day.										Dry Matter consumed per Day (Pounds).	Milk produced per Day (Quarts).	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Buffalo Gluten Feed.	Cotton-seed Meal.	Hay.	Rowen.	Corn Stover.	Hay of Peas and Oats.	Corn and Soja-bean Ensilage.	Soja-bean and Corn Ensilage.	Mangolds.					
1892-93.															
Oct. 18 to Nov. 9,	3.00	3.00	3.00	15.00	–	–	–	–	–	–	21.88	10.46	2.09	1:4.5	944
Nov. 14 to Dec. 3,	3.00	3.00	3.00	15.00	–	–	–	–	–	15.00	23.60	10.58	2.23	1:4.9	974
Dec. 12 to Jan. 10,	3.00	3.00	3.00	–	–	13.17	–	–	–	–	19.47	7.12	2.73	1:4.6	962
Jan. 18 to April 4,	3.00	3.00	3.00	4.00	–	–	–	49.86	–	–	22.95	9.31	2.47	1:4.9	1,010
May 1 to May 26,	3.00	3.00	3.00	4.00	–	–	–	–	51.18	–	21.93	8.28	2.65	1:5.0	1,004
June 8 to June 22,	3.00	3.00	3.00	–	–	–	15.43	–	–	–	21.76	7.19	3.03	1:3.6	1,088
June 27 to July 6,	3.00	3.00	3.00	–	18.00	–	–	–	–	–	24.19	7.52	3.22	1:4.5	1,064

FEEDING RECORD — *Concluded.*

Nora.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.								Dry Matter consumed per Day (Pounds).	Milk produced per Day (Quarts).	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Buffalo Gluten Feed.	Cotton-seed Meal.	Hay.	Rowen.	Hay of Peas and Oats.	Corn and Soja-bean Ensilage.	Soja-bean and Corn Ensilage.					
1892-93.													
May 1 to May 26, .	3.00	3.00	3.00	4.00	–	–	–	49.14	21.53	11.45	1.88	1:5.00	730
June 8 to June 22, .	3.00	3.00	3.00	–	–	13.71	–	–	19.65	10.48	1.88	1:3.50	744
June 27 to July 6, .	3.00	3.00	3.00	–	16.00	–	–	–	22.42	10.59	2.12	1:4.40	743
Jennie.													
Feb 12 to April 4, .	3.00	3.00	3.00	4.00	–	–	40.45	–	20.86	10.80	1.93	1:4.80	706
May 1 to May 26, .	3.00	3.00	3.00	4.00	–	–	–	45.16	20.75	9.48	2.19	1:4.90	728
June 8 to June 22, .	3.00	3.00	3.00	–	–	14.71	–	–	21.13	8.66	2.44	1:3.55	759
June 27 to July 6, .	3.00	3.00	3.00	–	16.00	–	–	–	22.42	8.19	2.74	1:4.40	740
Julia.													
Feb. 20 to April 4, .	3.00	3.00	3.00	4.00	–	–	47.44	–	22.42	12.88	1.74	1:4.90	824
May 1 to May 26, .	3.00	3.00	3.00	4.00	–	–	–	50.22	21.75	11.51	1.89	1:5.00	801
June 27 to July 6, .	3.00	3.00	3.00	–	16.00	–	–	–	22.42	9.30	2.41	1:4.40	790

TOTAL COST OF FEED PER QUART OF MILK.

May.

FEEDING PERIODS.	Quantity of Milk produced (Quarts).	Average Daily Yield (Quarts).	Wheat Bran consumed (Pounds).	Buffalo Gluten Feed consumed (Pounds).	Cotton-seed Meal consumed (Pounds).	Hay consumed (Pounds).	Corn Stover consumed (Pounds).	Globe Mangolds consumed (Pounds).	Total Cost of Feed consumed.	Cost of Feed per Quart of Milk produced (Cents).
1892-93.										
Oct. 18 to Nov. 9,	139.48	6.34	66.00	66.00	66.00	330.00	–	–	$4 69	3.36
Nov. 14 to Dec. 3,	122.93	6.47	57.00	57.00	57.00	285.00	–	285.00	4 62	3.75
Dec. 12 to Jan. 9,	138.04	4.93	84.00	84.00	84.00	–	376.00	–	3 75	2.72
Viola.										
Oct. 18 to Nov. 9,	128.14	5.83	66.00	66.00	66.00	330.00	–	–	$4 69	3.65
Nov. 14 to Dec 3,	99.41	5.23	57.00	57.00	57.00	281.00	–	285.00	4 58	4.61
Dec. 12 to Jan. 4,	86.12	3.74	69.00	69.00	69.00	–	382.00	–	3 26	3.78
Anna.										
Oct. 18 to Nov. 9,	127.07	5.80	66.00	66.00	66.00	330.00	–	–	$4 69	3.69
Nov. 14 to Dec. 3,	108.30	5.70	57.00	57.00	57.00	194.00	–	285.00	3 93	3.60
Dec. 12 to Jan. 4,	109.25	4.75	69.00	69.00	69.00	–	271.00	–	2 97	2.72

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

Gem.

FEEDING PERIODS.	Quantity of Milk produced (Quarts).	Average Daily Yield (Quarts).	Wheat Bran consumed (Pounds).	Buffalo Gluten Feed consumed (Pounds).	Cotton-seed Meal consumed (Pounds).	Hay consumed (Pounds).	Rowen consumed (Pounds).	Corn Stover consumed (Pounds).	Hay of Peas and Oats consumed (Pounds).	Corn and Soja-bean Ensilage consumed (Pounds).	Soja-bean and Corn Ensilage consumed (Pounds).	Globe Mangolds consumed (Pounds).	Total Cost of Feed consumed.	Cost of Feed per Quart of Milk produced (Cents).
1892-93.														
Oct. 18 to Nov. 9, .	244.51	11.11	66.00	66.00	66.00	330.00	–	–	–	–	–	–	$4 69	1.88
Nov. 14 to Dec. 3, .	226.67	11.93	57.00	57.00	57.00	285.00	–	–	–	–	–	285.00	4 62	2.04
Dec. 12 to Jan 10, .	268.54	9.26	87.00	87.00	87.00	–	–	387.00	–	–	–	–	3 87	1.44
Jan. 18 to April 4, .	927.96	12.21	223.50	223.50	223.50	304.00	–	–	–	3,285.00	–	–	14 53	1.56
May 1 to May 26, .	294.00	11.76	72.00	72.00	72.00	100.00	–	–	–	–	1,293.00	–	4 97	1.69
June 8 to June 22, .	144.48	10.32	42.00	42.00	42.00	–	–	–	206.00	–	–	–	2 95	2.04
June 27 to July 6, .	99.27	11.03	27.00	27.00	27.00	–	154.00	–	–	–	–	–	2 05	2.04

Lucy.

FEEDING PERIODS.	Quantity of Milk produced (Quarts).	Average Daily Yield (Quarts).	Wheat Bran consumed (Pounds).	Buffalo Gluten Feed consumed (Pounds).	Cotton-seed Meal consumed (Pounds).	Hay consumed (Pounds).	Rowen consumed (Pounds).	Corn Stover consumed (Pounds).	Hay of Peas and Oats consumed (Pounds).	Corn and Soja-bean Ensilage consumed (Pounds).	Soja-bean and Corn Ensilage consumed (Pounds).	Globe Mangolds consumed (Pounds).	Total Cost of Feed consumed.	Cost of Feed per Quart of Milk produced (Cents).
Oct. 18 to Nov. 9, .	185.90	8.45	66.00	66.00	66.00	330.00	–	–	–	–	–	–	$4 69	2.52
Nov. 14 to Dec. 3, .	167.96	8.84	57.00	57.00	57.00	285.00	–	–	–	–	–	285.00	4 62	2.75
Dec. 12 to Jan. 10, .	193.02	6.65	87.00	87.00	87.00	–	–	357.00	–	–	–	–	3 80	1.97
Feb. 18 to Mar. 15, .	182.50	7.30	75.00	75.00	75.00	100.00	–	–	–	646.00	–	–	4 16	2.28

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

Florence.

FEEDING PERIODS.	Quantity of Milk produced (Quarts).	Average Daily Yield (Quarts).	Wheat Bran consumed (Pounds).	Buffalo Gluten Feed consumed (Pounds).	Cotton-seed Meal consumed (Pounds).	Hay consumed (Pounds).	Rowen consumed (Pounds).	Corn Stover consumed (Pounds).	Hay of Peas and Oats consumed (Pounds).	Corn and Soja-bean Ensilage consumed (Pounds).	Soja-bean and Corn Ensilage consumed (Pounds).	Globe Mangolds consumed (Pounds).	Total Cost of Feed consumed.	Cost of Feed per Quart of Milk produced (Cents).
Oct. 18 to Nov. 9, .	230.12	10.46	66.00	66.00	66.00	330.00	–	–	–	–	–	–	$4 68	2.03
Nov. 14 to Dec. 3, .	201.02	10.58	57.00	57.00	57.00	285.00	–	–	–	–	–	285.00	4 62	2.29
Dec. 12 to Jan 10, .	206.48	7.12	87.00	87.00	87.00	–	–	382.00	–	–	–	–	3 87	1.87
Jan. 18 to April 4, .	707.56	9.31	228.00	228.00	228.00	304.00	–	–	–	3,789.00	–	–	15 11	2.13
May 1 to May 26, .	207.00	8.28	75.00	75.00	75.00	100.00	–	–	–	–	1,279.00	–	5 05	2.44
June 8 to June 22, .	100.66	7.19	42.00	42.00	42.00	–	–	–	216.00	–	–	–	3 03	3.02
June 27 to July 6, .	67.67	7.52	27.00	27.00	27.00	–	172.00	–	–	–	–	–	2 14	3.16

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

Nora.

FEEDING PERIODS.	Quantity of Milk produced (Quarts).	Average Daily Yield (Quarts).	Wheat Bran consumed (Pounds).	Buffalo Gluten Feed consumed (Pounds).	Cotton-seed Meal consumed (Pounds).	Hay consumed (Pounds).	Rowen consumed (Pounds).	Hay of Peas and Oats consumed (Pounds).	Corn and Soja-bean Ensilage consumed (Pounds).	Soja-bean and Corn Ensilage consumed (Pounds).	Total Cost of Feed consumed.	Cost of Feed per Quart of Milk produced (Cents).
1893.												
May 1 to May 26, . .	286.25	11.45	75.00	75.00	75.00	100.00	–	–	–	1,229.00	$4 88	1.74
June 8 to June 22, . .	146.72	10.48	42.00	42.00	42.00	–	–	192.00	–	–	2 85	1.94
June 27 to July 6, . .	95.31	10.59	27.00	27.00	27.00	–	144.00	–	–	–	1 98	2.07

Jennie.

FEEDING PERIODS.	Quantity of Milk produced (Quarts).	Average Daily Yield (Quarts).	Wheat Bran consumed (Pounds).	Buffalo Gluten Feed consumed (Pounds).	Cotton-seed Meal consumed (Pounds).	Hay consumed (Pounds).	Rowen consumed (Pounds).	Hay of Peas and Oats consumed (Pounds).	Corn and Soja-bean Ensilage consumed (Pounds).	Soja-bean and Corn Ensilage consumed (Pounds).	Total Cost of Feed consumed.	Cost of Feed per Quart of Milk produced (Cents).
Feb. 12 to April 4, . .	248.40	10.80	69.00	69.00	69.00	92.00	–	–	930.00	–	$4 29	1.73
May 1 to May 26, . .	237.00	9.48	75.00	75.00	75.00	100.00	–	–	–	1,129.00	4 84	2.04
June 8 to June 22, . .	121.26	8.66	42.00	42.00	42.00	–	–	206.00	–	–	2 95	2.42
June 27 to July 6, . .	73.79	8.16	27.00	27.00	27.00	–	144.00	–	–	–	1 98	2.71

Julia.

FEEDING PERIODS.	Quantity of Milk produced (Quarts).	Average Daily Yield (Quarts).	Wheat Bran consumed (Pounds).	Buffalo Gluten Feed consumed (Pounds).	Cotton-seed Meal consumed (Pounds).	Hay consumed (Pounds).	Rowen consumed (Pounds).	Hay of Peas and Oats consumed (Pounds).	Corn and Soja-bean Ensilage consumed (Pounds).	Soja-bean and Corn Ensilage consumed (Pounds).	Total Cost of Feed consumed.	Cost of Feed per Quart of Milk produced (Cents).
Feb. 20 to April 4, . .	180.32	12.88	42.00	42.00	42.00	56.00	–	–	664.00	–	$2 80	1.55
May 1 to May 26, . .	287.75	11.51	75.00	75.00	75.00	100.00	–	–	–	1,256.00	5 01	1.74
June 27 to July 6, . .	83.70	9.30	27.00	27.00	27.00	–	144.00	–	–	–	1 98	2.37

2. Summer Feeding Experiments with Milch Cows.

July, 1892, to September, 1892.

[Coarse fodder articles: rowen, green vetch and oats and green corn fodder; grain feed: wheat bran, Buffalo gluten feed, cotton-seed meal and new process linseed meal.]

Object of the Experiment.

This experiment had for its object the studying of the comparative value of three distinct fodder rations on the economical production of milk and cream during the summer season.

The first ration consisted of green vetch and oats *ad libitum,* four pounds of rowen and three pounds each of wheat bran, Buffalo gluten feed and cotton-seed meal.

The second ration consisted of rowen *ad libitum* and three pounds each of wheat bran, Buffalo gluten feed and new-process linseed meal.

The third ration consisted of four pounds of rowen, all the corn fodder the animal could eat, and three pounds each of wheat bran, Buffalo gluten feed and new-process linseed meal.

The vetch and oats were cut when in bloom, and the corn fodder when the kernels were beginning to glaze.

Four pounds of rowen were fed daily in connection with the green fodder. The daily consumption of green fodder was governed by the individual appetite of the animals, and usually decreased with the advancing stage of growth of the fodder plant. The feeding of the green crops ceased as soon as they neared maturity, and they were then cut and made into hay, or, in the case of corn fodder, placed in the silo.

The cows were grades of various description, and the general management of the experiment was the same as in the one immediately preceding.

History of Cows.

Name of Cow.	Breed.	Age (Years).	Last Calf dropped.	Daily Yield of Milk at Beginning of Trial (Quarts).	Number of Months on Trial.
Jennie,	Grade Jersey,	4	Dec. 25, 1892,	8–9	7
Gem,	Grade Shorthorn,	5	Dec. 6, 1891,	7–8	17
Florence,	Grade Shorthorn,	7	May 13, 1892,	9–10	14
Julia,	Native,	9	Jan. 18, 1893,	9–10	6
Nora,	Grade Ayrshire,	5	Mar. 25, 1893,	10–11	4
Nettie,	Grade Holstein,	5	July 2, 1893,	15–16	–

Local Market Cost per Ton of the Various Articles of Fodder.

Wheat bran,	$18 00
Buffalo gluten feed,	19 00
Cotton-seed meal,	28 00
New-process linseed meal,	26 00
Rowen,	15 00
Vetch and oats (green),	2 75
Corn fodder (green),	2 50

Analyses of the Various Articles of Fodder used.

Fodder Analyses.	Wheat Bran.	Buffalo Gluten Feed.	Cotton-seed Meal.	New-process Linseed Meal.	Rowen.	Vetch and Oats.	Corn Fodder.
Moisture at 100° C.,	12.00	9.38	8.71	10.62	11.30	79.16	80.89
Dry matter,	88.00	90.62	91.29	89.38	88.70	20.84	19.11
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.							
Crude ash,	7.70	0.98	7.62	5.89	6.48	8.80	6.29
" cellulose,	11.10	8.06	8.28	8.84	29.98	30.34	26.38
" fat,	5.80	14.47	9.50	3.94	4.23	3.90	1.75
" protein,	17.83	25.79	43.56	40.79	12.11	13.27	6.05
Non-nitrogenous extract matter,	57.57	50.70	31.04	40.54	47.20	43.69	59.53
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 17½ cents, phosphoric acid 5 cents, potassium oxide 5½ cents, per pound.]

FERTILIZER ANALYSES.	Wheat Bran.	Buffalo Gluten Feed.	Cotton-seed Meal.	New-process Linseed Meal.	Rowen.	Vetch and Oats.	Corn Fodder.
Moisture,	12.00	9.38	8.71	10.62	11.30	79.16	80.89
Nitrogen,	2.51	3.74	6.36	5.84	1.72	0.44	0.19
Phosphoric acid,	2.85	0.46	3.17	1.95	0.47	0.13	0.15
Potassium oxide,	1.63	0.10	2.25	1.08	1.63	0.42	0.33
Valuation per 2,000 pounds,	$13 39	$13 64	$27 90	$23 58	$8 28	$2 13	$1 17
Manurial value obtainable,	10 71	10 91	22 32	18 64	6 62	1 70	0 94

Average Composition of the Daily Fodder Rations used during the Three Successive Feeding Periods.

I.		II.	
July 13 to July 24.		*August 10 to August 28.*	
Wheat bran,	3 lbs.	Wheat bran,	3 lbs.
Buffalo gluten feed,	3 "	Buffalo gluten feed,	3 "
Cotton-seed meal,	3 "	New-process linseed meal,	3 "
Rowen,	4 "	Rowen,	18 "
Vetch and oats,	40 "	Nutritive ratio,	1:4.41
Nutritive ratio,	1:3 79	Total cost,	22.95 cts.
Total cost,	18.25 cts.	Manurial value obtainable,	12.00 "
Manurial value obtainable,	11.32 "	Net cost,	10.95 "
Net cost,	6.93 "		

III.	
September 4 to September 28.	
Wheat bran,	3 lbs.
Buffalo gluten feed,	3 "
New-process linseed meal,	3 "
Rowen,	4 "
Corn fodder,	55 "
Nutritive ratio,	1:5.06
Total cost,	19.33 cts.
Manurial value obtainable,	9.95 "
Net cost,	9.38 "

Summary of Cost of the Average Daily Fodder Rations.

[Cents.]

	Feeding Periods.		
	I.	II.	III.
Total cost,	18.25	22.95	19.33
Manurial value obtainable,	11.32	12.00	9.95
Net cost,	6.93	10.95	9.38

Quantity of Milk produced per Day, and Cost of Same per Quart.

Feeding Periods.	Jennie.		Gem.		Florence.		Julia.		Nora.		Nettie.	
	Daily Yield.	Cost per Quart.	Daily Yield.	Cost per Quart	Daily Yield.	Cost per Quart.	Daily Yield.	Cost per Quart.	Daily Yield.	Cost per Quart.	Daily Yield.	Cost per Quart.
	Qts.	Cts.	Qts.	Cts.	Qts.	Cts.	Qts.	Cts.	Qts.	Cts.	Qts.	Cts.
I.,	7.36	2.40	6.87	2.75	9.37	2.02	9.00	1.96	9.64	1.83	–	–
II.,	7.12	3.22	8.94	2.41	7.02	3.28	8.95	2.54	9.02	2.55	14.27	1.61
III.,	6.43	2.81	8.40	2.18	6.01	3.09	8.26	2.19	8.89	2.09	15.83	1.25

Composition of Milk produced.

Feeding Periods.	Rations.	Jennie.		Gem.		Florence.		Julia.		Nora.		Nettie.	
		Total Solids.	Fat.	Total Solids.	Fat.	Total Solids.	Fat.	Total Solids.	Fat.	Total Solids.	Fat.	Total Solids.	Fat.
I. Ten days, . .	Wheat bran, Buffalo gluten feed, cotton-seed meal, rowen and vetch and oats,	15.01	5.55	13.75	3.95	13.59	4.83	13.39	4.85	13.18	4.08	–	–
		15.01	5.55	13.75	3.95	13.59	4.83	13.39	4.85	13.18	4.08	–	–
II. Eighteen days, .	Wheat bran, Buffalo gluten feed, new-process linseed meal and rowen, . .	14.54	4.28	13.56	4.76	14.28	4.83	13.72	4.30	13.07	3.89	12.37	3.56
		14.55	5.06	12.80	4.08	13.81	4.81	13.62	4.72	13.46	4.78	12.63	3.86
		14.54	4.67	13.18	4.42	14.04	4.82	13.67	4.51	13.26	4.34	12.50	3.71
III. Twenty-four days,	Wheat bran, Buffalo gluten feed, new-process linseed meal, rowen and corn fodder, ...	15.87	6.09	13.77	4.64	14.75	5.11	14.78	5.38	13.58	–	12.60	3.80
		15.49	5.10	13.55	3.85	14.09	4.05	14.48	4.35	13.47	3.30	12.59	3.30
		15.16	5.61	13.18	4.00	–	–	14.67	4.80	12.27	2.65	12.68	3.65
		15.84	5.60	13.50	4.16	14.42	4.58	14.64	4.84	13.11	2.98	12.62	3.58

Results of the Experiment.

There is a gradual decline in the yield of milk in case of four out of the six cows, owing to a rather advanced period of lactation. Nevertheless, it is to be observed that all three rations produced a very fair yield of milk, but the cost of the same differs. The average cost per quart for the six cows in the second feeding period, where rowen was the coarse feed, was 2.60 cents. In the first feeding period, where green vetch and oats was the chief coarse fodder, the average cost in case of five cows was 2.19 cents per quart; while in the third period, where green fodder corn was the chief coarse fodder, the average cost for the six cows was 2.30 cents per quart. In case, therefore, of feeding periods I. and III., milk is produced at an average price of 2¼ cents per quart, which is fairly low, considering the advanced period of lactation of three of the cows. In feeding period II., on the other hand, the milk cost 2.60 cents per quart, which shows that other cheaper coarse fodders must be substituted for the costly hay in order to produce milk at a minimum cost.

As far as the effect of feed upon the quality of the milk is concerned, there appears to be no distinct steady increase or decrease in composition. Variations are noticeable, generally slight ones, from week to week in the composition of each cow's milk. In one or two cases these differences are quite marked, being as high as one per cent. in case of fat; but it is plainly evident that such variations are brought about by the condition of the animal, and not by particular influence of the feed.

The results in previous years, with soja-bean, Southern cow-pea, serradella, green rye and peas and oats have already been published. They point out clearly the fact that a well-regulated system of feeding the dairy stock during the summer is necessary in order to secure the most satisfactory results.

FEEDING RECORD.

Jennie.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Dry Matter consumed per Day (Pounds).	Milk produced per Day (Quarts).	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Buffalo Gluten Feed.	Cotton-seed Meal.	New-process Linseed Meal.	Rowen.	Vetch and Oats.	Corn Fodder.					
1893.												
July 13 to July 24, . . .	3.00	3.00	3.00	–	4.00	36.00	–	19.15	7.36	2.60	1:3.70	750
Aug. 10 to Aug. 28, . . .	3.00	3.00	–	3.00	18.00	–	–	24.01	7.12	3.37	1:4.41	763
Sept. 4 to Sept. 28, . . .	3.00	3.00	–	3.00	4.00	–	47.71	20.71	6.43	3.22	1:5.00	734

Gem.

FEEDING PERIODS.	Wheat Bran.	Buffalo Gluten Feed.	Cotton-seed Meal.	New-process Linseed Meal.	Rowen.	Vetch and Oats.	Corn Fodder.	Dry Matter consumed per Day (Pounds).	Milk produced per Day (Quarts).	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
July 13 to July 24, . . .	3.00	3.00	3.00	–	4.00	45.00	–	21.02	6.87	3.06	1:3.85	1,090
Aug. 10 to Aug. 28, . . .	3.00	3.00	–	3.00	16.83	–	–	22.97	8.94	2.57	1:4.36	998
Sept. 4 to Sept. 28, . . .	3.00	3.00	–	3.00	4.00	–	49.54	21.06	8.40	2.51	1:5.00	983

Florence.

FEEDING PERIODS.	Wheat Bran.	Buffalo Gluten Feed.	Cotton-seed Meal.	New-process Linseed Meal.	Rowen.	Vetch and Oats.	Corn Fodder.	Dry Matter consumed per Day (Pounds).	Milk produced per Day (Quarts).	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
July 13 to July 24, . . .	3.00	3.00	3.00	–	4.00	45.00	–	21.02	9.37	2.24	1:3.85	1,005
Aug. 10 to Aug. 28, . . .	3.00	3.00	–	3.00	18.00	–	–	21.01	7.02	3.42	1:4.41	1,020
Sept. 4 to Sept. 28, . . .	3.00	3.00	–	3.00	4.00	–	51.43	21.42	6.07	3.53	1:5.00	1,044

Julia.

July 13 to July 24, . . .	3.00	3.00	3.00	–	4.00	36.00	–	19.15	9.00	2.13	1:3.70	795
Aug. 10 to Aug. 28, . . .	3.00	3.00	–	3.00	17.72	–	–	23.76	8.95	2.65	1:4.40	808
Sept. 4 to Sept. 28, . . .	3.00	3.00	–	3.00	4.00	–	48.10	20.78	8.26	2.52	1:5.00	818

Nora.

July 13 to July 24, . . .	3.00	3.00	3.00	–	4.00	36.00	–	19.15	9.64	1.99	1:3.70	740
Aug. 10 to Aug. 28, . . .	3.00	3.00	–	3.00	18.00	–	–	24.01	9.02	2.66	1:4.41	748
Sept. 4 to Sept. 28, . . .	3.00	3.00	–	3.00	4.00	–	51.80	21.49	8.89	2.42	1:5.00	762

Nettie.

Aug. 10 to Aug. 28, . . .	3.00	3.00	–	3.00	18.00	–	–	24.01	14.27	1.68	1:4.41	811
Sept. 4 to Sept. 28, . . .	3.00	3.00	–	3.00	4.00	–	59.15	22.89	15.83	1.45	1:5.10	831

Total Cost of Feed per Quart of Milk.

Feeding Periods.	Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Wheat Bran consumed (Pounds).	Buffalo Gluten Feed consumed (Pounds).	Cotton-seed Meal consumed (Pounds).	Linseed Meal consumed (Pounds).	Rowen consumed (Pounds).	Green Vetch and Oats consumed (Pounds).	Corn Fodder consumed (Pounds).	Total Cost of Feed consumed.	Cost of Feed per Quart of Milk (Cents).
Jennie.											
1893.											
July 13 to July 24, . .	80.96	7.36	33.00	33.00	33.00	–	44.00	396.00	–	$1 94	2.40
Aug. 10 to Aug. 28, . .	128.16	7.12	54.00	54.00	–	54.00	324.00	–	–	4 13	3.22
Sept. 4 to Sept. 28, . .	154.32	6.43	72.00	72.00	–	72.00	96.00	–	1,145.00	4 34	2.81
Gem.											
July 13 to July 24, . .	75.57	6.87	33.00	33.00	33.00	–	44.00	495.00	–	$2 08	2.76
Aug. 10 to Aug. 28, . .	160.92	8.94	54.00	54.00	–	54.00	303.00	–	–	3 97	2.47
Sept. 4 to Sept. 28, . .	201.60	8.40	72.00	72.00	–	72.00	96.00	–	1,189.00	4 39	2.18
Florence.											
July 13 to July 24, . .	103.07	9.37	33.00	33.00	33.00	–	44.00	495.00	–	$2 08	2.02
Aug. 10 to Aug. 28, . .	126.36	7.02	54.00	54.00	–	54.00	324.00	–	–	4 43	3.27
Sept. 4 to Sept. 19, . .	91.05	6.07	45.00	45.00	–	45.00	60.00	–	763.00	2 82	3.09

Julia.

July 13 to July 24, . .	99.00	9.00	33.00	33.00	33.00	–	44.00	396.00	–	$1 94	1.96
Aug. 10 to Aug. 28, . .	161.10	8.95	54.00	54.00	–	54.00	319.00	–	–	4 09	2.54
Sept. 4 to Sept. 28, . .	198.24	8.26	72.00	72.00	–	72.00	96.00	–	1,154.00	4 35	2.19

Nora.

July 13 to July 24, . .	106.04	9.64	33.00	33.00	33.00	–	44.00	396.00	–	$1 94	1.83
Aug. 10 to Aug. 28, . .	162.36	9.02	54.00	54.00	–	54.00	324.00	–	–	4 13	2.54
Sept. 4 to Sept. 28, . .	213.36	8.89	72.00	72.00	–	72.00	96.00	–	1,243.00	4 46	2.09

Nettie.

Aug. 10 to Aug. 28, . .	256.86	14.27	54.00	54.00	–	54.00	324.00	–	–	$4 13	1.61
Sept. 4 to Sept. 28, . .	379.92	15.83	72.00	72.00	–	72.00	96.00	–	1,419.00	4 68	1.23

3. Creamery Record of the Station for 1892 and 1893.

The cost of feed consumed is based on the market prices stated below. The valuation of the whole milk is taken at three cents per quart.

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran,	$19 00
Buffalo gluten feed,	20 00
Cotton-seed meal,	28 00
New-process linseed meal,	26 00
Hay,	15 00
Rowen,	15 00
Corn fodder (green),	2 50
Corn stover,	5 00
Corn and soja-bean ensilage,	2 75
Soja-bean and corn ensilage,	2 75
Serradella and Hungarian grass ensilage,	2 75
Hay of peas and oats,	15 00
Hay of vetch and oats,	15 00
Vetch and oats (green),	2 50
Buckwheat (green),	2 50
Vetch (green),	3 00
Globe mangolds,	4 00

Fertilizing Constituents.

[Nitrogen 17½ cents, phosphoric acid 5 cents, potassium oxide 5½ cents, per pound.]

	Moisture.	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	Valuation per 2,000 Pounds.
Wheat bran,	11.17	2.48	2.85	1.63	$13 31
Buffalo gluten feed,	8.83	3.78	0.05	0.10	13 80
Cotton-seed meal,	7.85	6.47	2.75	1.98	27 57
New-process linseed meal,	10.62	5.84	1.95	1.08	23 58
Hay,	9.00	1.52	0.35	1.54	7 36
Rowen,	11.30	1.72	0.47	1.63	8 28
Corn fodder (green),	80.89	0.19	0.15	0.33	1 17
Corn stover,	14.66	0.55	3.23	1.84	7 17
Corn and soja-bean ensilage,	77.77	0.32	0.12	0.48	1 77
Soja-bean and corn ensilage,	80.33	0.27	0.12	0.48	1 59
Serradella and Hungarian grass ensilage,	80.83	0.45	0.12	0.48	2 22
Hay of peas and oats,	12.30	2.24	0.65	2.10	10 80
Hay of vetch and oats,	9.95	2.44	0.65	2.10	11 50
Vetch and oats (green),	79.16	0.44	0.13	0.42	2 13
Buckwheat (green),	85.00	0.39	0.08	0.38	1 86
Vetch (green),	82.00	0.56	0.21	0.17	2 35
Globe mangolds,	88.51	0.13	0.10	0.47	1 07

Fertilizing Constituents of Cream.

[Average Analysis.]

	Per Cent.
Moisture at 100° C.,	72.00–74.00
Nitrogen (17½ cents per pound),	0.54
Phosphoric acid (5 cents per pound),	0.17
Potassium oxide (5½ cents per pound),	0.12

The monthly value placed upon the cream is the price paid for the same by the local creamery. The financial statement is based on the local cost of feed, and does not take into consideration interest on investment or cost of labor involved.

The results here presented are stated under the following separate headings: —

1. Statement of articles of fodder used.
2. Record of average quality of milk and fodder rations.
3. Value of cream at creamery basis of valuation.
4. Cost of skim-milk on the basis of three cents per quart for whole milk.
5. What the creamery records show.
6. Analyses of cream and butter fat.

1. *Statement of Articles of Fodder used during 1892 (Pounds).*

1892.	Wheat Bran.	Gluten Feed.	Maize Feed.	Cotton-seed Meal.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Corn Ensilage.	Green Rye.	Canada Peas and Oats.	Vetch.	Vetch and Oats.	Rape.	Serradella.	Sugar Beets.	Cabbages.
January,	523.50	-	523.50	523.50	570.00	-	-	714.00	3,768.00	-	-	-	-	-	-	-	-
February,	516.00	-	516.00	516.00	870.00	-	-	-	6,292.00	-	-	-	-	-	-	-	-
March,	549.00	150.00	396.00	549.00	870.00	615.00	-	-	4,604.00	-	-	-	-	-	-	840.00	-
April,	450.00	450.00	-	450.00	-	2,250.00	-	-	-	-	-	-	-	-	-	2,250.00	-
May,	465.00	465.00	-	465.00	-	1,855.00	-	-	-	850.00	-	-	-	-	-	1,500.00	-
June,	540.00	540.00	-	540.00	-	900.00	-	-	-	1,254.00	2,220.00	-	540.00	-	-	-	-
July,	558.00	558.00	-	558.00	-	930.00	-	-	-	-	-	-	6,776.00	-	-	-	-
August,	558.00	558.00	-	558.00	-	930.00	6,102.00	-	-	-	-	1,380.00	-	882.00	-	-	2,016.00
September,	540.00	540.00	-	540.00	-	900.00	7,781.00	-	-	-	-	-	-	297.00	2,130.00	-	-
October,	558.00	558.00	-	558.00	-	270.00	1,119.00	-	-	-	-	-	-	162.00	1,008.00	-	180.00
November,	540.00	540.00	-	540.00	2,575.00	-	-	-	-	-	-	-	-	-	-	1,980.00	-
December,	558.00	558.00	-	558.00	315.00	-	-	2,159.00	-	-	-	-	-	-	-	540.00	-

1. Statement of Articles of Fodder used during 1893 (Pounds).

1893.	Wheat Bran.	Buffalo Gluten Feed.	Cotton-seed Meal.	New-process Linseed Meal.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Corn and Soja-bean Ensilage.	Soja-bean and Corn Ensilage.	Serradella and Hungarian Grass Ensilage.	Peas and Oats (Dry).	Vetch and Oats (Dry).	Vetch and Oats (Green).	Buckwheat (Green).	Vetch (Green).
January,	489.00	489.00	442.00	-	1,080.00	-	-	742.50	2,968.50	-	-	-	-	-	-	-
February,	504.00	504.00	491.00	-	798.00	-	-	-	7,084.00	-	-	-	-	-	-	-
March,	516.00	516.00	507.00	-	721.00	-	-	-	9,103.00	-	-	-	-	-	-	-
April,	507.00	507.00	426.00	-	781.00	-	-	-	2,530.00	1,370.00	4,751.00	-	-	-	-	-
May,	555.00	555.00	555.00	-	753.00	-	-	-	-	9,233.00	-	-	448.00	-	-	-
June,	540.00	540.00	540.00	-	-	942.00	-	-	-	-	-	1,564.00	184.00	-	-	-
July,	558.00	558.00	409.50	130.50	-	1,820.00	-	-	-	-	-	-	-	3,880.00	-	-
August,	558.00	558.00	-	558.00	-	2,726.00	-	-	-	-	-	-	-	-	633.00	252.00
September,	531.00	531.00	-	519.00	264.00	636.00	948.00	-	-	-	-	-	-	-	-	-
October,	558.00	558.00	-	558.00	1,757.00	-	7,818.00	-	-	-	-	-	-	-	-	-

2. *Record of Average Quality of Milk and of Fodder Rations (1892).*

1892.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed (Pounds) per Day.													
					Wheat Bran.	Gluten Feed.	Maize Feed.	Cotton-seed Meal.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Corn Ensilage.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Serradella.	Sugar Beets.
January, ...	13.75	4.55	1.73	1:4.63 –	3.00 3.00	– –	3.00 3.00	3.00 3.00	– 5.00	– –	– –	12.06 –	– 32.00	– –	– –	– –	– –	– –
February, ...	13.24	4.36	1.70	1:4.64	3.00	–	3.00	3.00	5.00	–	–	–	32.00	–	–	–	–	–
March, ...	12.98	4.10	1.58	1:4.81	3.00	–	3.00	3.00	5.00	–	–	–	41.39	–	–	–	–	–
April, ...	13.09	4.01	1.72	1:4.48	3.00	3.00	–	3.00	–	15.00	–	–	–	–	–	–	–	15.00
May, ...	13.00	3.92	1.77	1:4.80	3.00	3.00	–	3.00	–	15.00	–	–	–	–	–	–	–	15.00
June, ...	13.43	4.28	2.09	1:3.78 1:3.70	3.00 3.00	3.00 3.00	– –	3.00 3.00	– –	5.00 5.00	– –	– –	– –	16.22 –	– 27.50	– –	– –	– –
July, ...	12.80	3.73	1.82	1:3.76	3.00	3.00	–	3.00	–	5.00	–	–	–	–	–	37.71	–	–
August, ...	12.30	3.50	2.08	1:5.00	3.00	3.00	–	3.00	–	5.00	50.00	–	–	–	–	–	–	–
September, ...	12.55	3.66	1.88	1:5.70 1:4.60	3.00 3.00	3.00 3.00	– –	3.00 3.00	– –	5.00 5.00	70.00 30.00	– –	– –	– –	– –	– –	– 20.00	– –
October, ...	13.17	3.77	1.85	1:5.22 1:4.50	3.00 3.00	3.00 3.00	– –	3.00 3.00	– 15.00	– –	30.00 –	– –	– –	– –	– –	– –	20.00 –	– –
November, ...	13.45	3.85	1.86	1:4.90	3.00	3.00	–	3.00	14.19	–	–	–	–	–	–	–	–	15.00
December, ...	13.66	4.33	1.80	1:4.80	3.00	3.00	–	3.00	–	–	–	15.00	–	–	–	–	–	15.00
Averages, ...	13.12	4.01	1.82	1:4.95														

2. *Record of Average Quality of Milk and of Fodder Rations (1893).*

1893.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed (Pounds) per Day. Wheat Bran.	Gluten Feed.	Cotton-seed Meal.	New-process Linseed Meal.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Corn and Soja-bean Ensilage.	Soja-bean and Corn Ensilage.	Serradella and Hungarian Grass Ensilage.	Peas and Oats (Dry).	Vetch and Oats (Dry).	Vetch and Oats (Green).
January,	13.80	4.77	1.66	1:4.80	3.00	3.00	3.00	–	–	–	–	15.00	–	–	–	–	–	–
				1:4.00	3.00	3.00	3.00	–	9.47	–	–	–	22.48	–	–	–	–	–
February,	13.82	4.73	1.70	1:4.80	3.00	3.00	3.00	–	4.75	–	–	–	42.16	–	–	–	–	–
March,	14.01	4.71	1.75	1:4.80	3.00	3.00	3.00	–	4.00	–	–	–	46.68	–	–	–	–	–
April,	13.73	4.67	1.93	1:4.90	3.00	3.00	3.00	–	4.00	–	–	–	50.00	–	–	–	–	–
				1:4.50	3.00	3.00	1.00	–	4.00	–	–	–	–	–	50.00	–	–	–
May,	13.74	4.51	1.94	1:5.00	3.00	3.00	3.00	–	4.00	–	–	–	–	54.95	–	–	–	–
				1:3.50	3.00	3.00	3.00	–	–	–	–	–	–	–	–	–	12.50	–
June,	13.81	4.42	1.83	1:3.60	3.00	3.00	3.00	–	–	–	–	–	–	–	–	15.60	–	–
				1:4.40	3.00	3.00	3.00	–	–	16.00	–	–	–	–	–	–	–	–
July,	13.67	4.52	1.81	1:4.40	3.00	3.00	3.00	–	–	16.00	–	–	–	–	–	–	–	–
				1:3.79	3.00	3.00	3.00	–	–	4.00	–	–	–	–	–	–	–	40.00
August,	13.64	4.52	2.00	1:4.50	3.00	3.00	–	3.00	–	18.00	–	–	–	–	–	–	–	–
September,	13.96	4.53	1.98	1:4.90	3.00	3.00	–	3.00	–	4.00	46.00	–	–	–	–	–	–	–
October,	14.01	4.84	1.99	1:4.50	3.00	3.00	–	3.00	17.60	–	–	–	–	–	–	–	–	–
				1:3.79	3.00	3.00	–	3.00	–	–	–	–	–	–	–	–	16.00	–
Averages,	13.82	4.62	1.86	1:4.38														

3. Value of Cream at Creamery Basis of Valuation.

	Total Cost of Feed consumed.	Total Value of Fertilizing Constituents of Food consumed.	Value of Fertilizing Constituents lost in Cream.	Net Cost of Feed for Production of Cream.	Value of Cream produced.
1892.					
January,	$31 07	$17 51	$0 55	$14 11	$34 64
February,	34 38	18 36	0 62	16 64	38 95
March,	38 50	20 95	0 76	18 31	45 04
April,	38 47	21 04	0 65	18 08	36 59
May,	35 23	20 13	0 67	15 77	31 65
June,	31 28	19 44	0 57	12 41	27 50
July,	36 11	22 80	0 58	13 89	28 69
August,	39 94	23 95	0 56	16 57	32 22
September,	38 95	22 93	0 55	16 57	33 72
October,	40 12	22 14	0 57	18 55	34 84
November,	43 33	21 29	0 45	22 49	31 00
December,	28 91	17 03	0 41	12 29	29 02
Averages,	$36 36	$20 63	$0 57	$16 31	$33 65
1893.					
January,	$30 41	$22 81	$0 67	$7 27	$41 69
February,	32 44	20 05	0 80	13 19	49 39
March,	35 07	24 91	0 91	11 07	56 32
April,	33 59	25 42	0 70	8 87	41 24
May,	40 29	27 98	0 70	13 01	38 95
June,	38 27	28 48	0 62	10 41	32 80
July,	36 81	26 34	0 61	10 58	31 57
August,	40 31	26 74	0 60	14 17	31 32
September,	33 61	18 99	0 55	15 17	32 88
October,	41 57	28 68	0 61	13 50	34 84
Averages,	$36 24	$25 08	$0 68	$11 72	$39 10

4. *Cost of Skim-milk on the Basis of Three Cents per Quart for Whole Milk.*

	Quarts of Milk produced.	Spaces of Cream.	Quarts of Cream (One Quart equals 3.4 Spaces).	Quarts of Skim-milk.	Value of Cream per Space (Cents).	Value of Cream per Quart of Milk (Cents).	Total Value of Cream.	Cost of Skim-milk per Quart (Whole Milk at Three Cents per Quart).	Total Cost of Skim-milk.
1892.									
January, .	1,460.3	845.0	248.5	1,211.8	4.10	2.38	$34 64	0.75	$9 16
February, .	1,612.4	950.0	279.4	1,333.0	4.10	2.42	38 95	0.71	9 42
March, . .	1,818.0	1,155.0	340.0	1,478.0	3.90	2.45	45 04	0.65	9 50
April, . .	1,704.4	989.0	290.9	1,413.5	3.70	2.14	36 59	1.03	14 54
May, . .	1,806.7	1,021.0	300.0	1,506.7	3.10	1.73	31 65	1.50	22 55
June, . .	1,818.5	873.0	256.8	1,561.7	3.15	1.51	27 50	1.73	27 05
July, . .	1,602.8	883.0	260.0	1,342.8	3.25	1.78	28 69	1.44	19 40
August, . .	1,765.8	848.0	249.4	1,516.4	3.80	1.80	32 22	1.36	20 76
September, .	1,581.4	843.0	248.0	1,333.4	4.00	2.12	33 72	1.03	13 71
October, . .	1,614.7	871.0	256.2	1,358.5	4.00	2.16	34 84	1.00	13 61
November, .	1,408.7	756.0	222.3	1,186.4	4.10	2.20	31 00	0.94	11 26
December, .	1,232.0	691.0	203.2	1,028.8	4.20	2.35	29 02	0.64	7 94
Averages, .	1,618.8	893.8	262.8	1,357.6	3.78	2.09	$33 66	1.07	$14 83
1893.									
January, .	1,625.2	981.0	288.5	1,336.5	4.25	2.57	$41 69	0.53	$7 06
February, .	2,007.4	1,176.0	345.9	1,651.5	4.20	2.46	49 39	0.66	10 83
March, . .	2,332.5	1,341.0	394.4	1,938.1	4.20	2.41	56 32	0.70	13 65
April, . .	2,008.7	1,031.0	303.2	1,705.5	4.00	2.05	41 24	1.11	19 02
May, . .	1,997.6	1,025.0	301.5	1,696.1	3.80	1.98	38 95	1.24	20 97
June, . .	1,668.6	911.0	267.9	1,400.7	3.60	1.96	32 80	1.23	17 25
July, . .	1,632.2	902.0	265.3	1,366.9	3.50	1.93	31 57	1.16	17 39
August, . .	1,743.9	870.0	258.9	1,495.0	3.60	1.61	31 32	1.41	20 99
September, .	1,605.6	822.0	241.8	1,363.8	4.00	2.04	32 88	1.12	15 28
October, . .	1,830.9	901.0	265.0	1,565.9	4.00	1.97	34 84	1.20	18 89
Averages, .	1,845.3	996.0	293.2	1,552.0	3.91	2.09	$39 10	1.03	$16 13

5. *What the Creamery Records Show.*

1. The nutritive ratio of the feed varied in 1892 from 1 : 3.70 to 1 : 5.70, with an average of 1 : 4.95 ; in 1893 from 1 : 3.50 to 1 : 5.00, with an average of 1 : 4.38.

2. The average monthly percentage of fat in the milk varied in 1892 from 3.50 to 4.55, with an average of 4.01 ; in 1893, from 4.42 to 4.84, with an average of 4.62.

3. The average monthly percentage of total solids varied in 1892 from 12.30 to 13.75, with an average of 13.12; in 1893, from 13.64 to 14.01, with an average of 13.82.

4. The relation of fat to solids not fat in 1892 was 1 : 2.29, while in 1893 it was 1 : 1.99.

5. The total cost of feed for one quart of cream amounted in 1892 to 13.84 cents and in 1893 to 12.36 cents.

6. The net cost of feed for one quart of cream amounted in 1892 to 6.21 cents and in 1893 to 4.00 cents.

7. The value received for one space of cream varied in 1892 from 3.10 to 4.20 cents, with an average of 3.78; in 1893, from 3.50 to 4.25, with an average of 3.91 cents; which amounted per quart (average) in 1892 to 12.85 cents, and in 1893 to 13.29 cents.

8. The number of quarts of milk required to produce one space of cream in 1892 was 1.81 and in 1893 1.85; or 6.16 quarts of whole milk to produce one quart of cream in 1892, and 6.29 quarts of whole milk to produceone quart of cream in 1893.

9. The net cost of feed per quart of cream averaged in 1892 6.21 cents and in 1893 4.00 cents. Received per quart of cream in 1892 12.85 cents and in 1893 13.34 cents, thereby securing a profit of 6.64 cents per quart in 1892 and 9.34 cents in 1893.

For further details concerning results in preceding years, see ninth annual report, pages 76 to 82, and tenth annual report, pages 48 to 55.

Our average statements for the current year apply in each case to only ten months, due to the fact that the financial settlement is made with our local creamery two months after the cream is furnished.

6. *Creamery Record, 1892–93. — Analyses of Cream and Butter Fat.*

Feeding Periods.	Date of Sampling.	Analysis of Cream.			Analysis of Fat.		Average Daily Fodder Rations.
		Solids.	Fat.	Solids not Fat.	Volatile Acids.	Non-volatile Acids.	
I.	Oct. 18,	25.63	16.00	9.63	–	–	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 15 pounds hay.
II.	Dec. 3,	25.28	16.90	8.38	–	–	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 15 pounds hay, 15 pounds sugar beets.
III.	Dec. 23,	25.55	17.00	8.55	–	–	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 15.9 pounds corn stover.
IV.	Jan. 19,	28.52	20.66	7.86	5.63	88.75	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 4 pounds hay, 48 pounds corn and soja-bean ensilage.
	Jan. 25,	26.30	18.00	8.30	5.77	87.45	
	Jan. 30,	27.50	18.83	8.67	5.57	87.42	
	Feb. 9,	27.03	18.55	8.48	5.73	87.00	
	Feb. 15,	27.19	19.55	7.64	5.48	87.33	
	Feb. 28,	28.23	20.23	8.00	5.98	86.80	
	March 6,	29.17	21.20	7.97	5.57	88.30	
	March 15,	30.00	22.25	7.75	5.39	87.15	
	March 21,	27.10	19.13	7.97	5.48	87.46	
	March 28,	26.19	18.44	7.75	5.75	86.55	
	April 4,	26.66	18.80	7.86	5.91	86.90	
V.	May 3,	27.11	19.01	8.10	5.81	87.71	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton seed meal, 4 pounds hay, 49.5 pounds soja-bean and corn ensilage.
	May 17,	25.45	17.85	7.60	5.45	87.47	
	May 23,	27.34	19.97	7.37	5.52	87.81	
VI.	June 8,	25.18	18.02	7.17	5.04	88.49	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 14.64 pounds hay of peas and oats.
	June 14,	27.31	19.08	8.23	5.38	87.45	
	June 22,	25.53	18.56	6.97	4.95	88.17	
VII.	June 28,	29.87	22.48	7.39	4.79	87.57	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 16.62 pounds rowen.
	July 5,	24.86	16.85	8.01	5.72	88.25	

6. Creamery Record, 1893. — Analyses of Cream and Butter Fat.

Feeding Periods.	Date of Sampling.	Analysis of Cream.			Analysis of Fat.		Average Daily Fodder Rations.
		Solids.	Fat.	Solids not Fat.	Volatile Acids.	Non-volatile Acids.	
I.	July 14,	31.60	23.99	7.61	–	–	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 4 pounds rowen, 39.60 pounds vetch and oats.
	July 19,	30.56	22.63	7.93	5.34	88.15	
II.	Aug. 12,	27.85	19.82	8.03	5.24	87.00	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds linseed meal, 17.76 pounds rowen.
	Aug. 17,	32.78	24.78	8.00	4.77	88.20	
	Aug. 22,	32.44	25.00	7.44	–	–	
III.	Sept. 5,	27.41	20.30	7.11	4.82	88.17	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds linseed meal, 4 pounds rowen, 51.29 pounds corn fodder.
	Sept. 12,	24.81	16.79	8.02	5.50	–	
	Sept. 29,	24.89	16.23	8.61	5.52	86.93	
IV.	Oct. 3,	24.63	16.01	8.62	5.88	86.79	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds linseed meal, 18 pounds hay.
	Oct. 13,	26.87	17.75	9.12	5.50	87.04	
	Oct. 20,	26.29	18.15	8.14	5.27	87.64	
V.	Oct. 25,	26.19	17.85	8.34	4.87	88.27	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds linseed meal, 16 pounds hay of vetch and oats.
	Oct. 31,	24.71	16.58	8.13	5.20	87.02	

II.

FOURTH FEEDING EXPERIMENT WITH STEERS.

1892–93.

General Description.

The experiment here described is a continuation of those published in our previous reports.

Two grades Shorthorn steers, yearlings, weighing about six hundred pounds each, were used in the experiment. They were quite thin when first received, and cost 3.5 cents per pound of live weight.

The coarse foods fed were raised upon the station grounds, and consisted principally of corn ensilage, corn stover, hay, green rye and a small quantity of roots.

The corn for ensilage was cut just as the kernels were glazing. The corn stover was the corn plant remaining after the fully matured ears had been removed.

The grains used were either equal weight parts of wheat bran and Chicago maize feed or wheat bran and Buffalo gluten feed.

The quantity of coarse fodders fed depended in all cases upon the individual appetite of the animals.

The animals were fed and watered twice each day, between five and six o'clock in the morning and at five in the afternoon, one-half of the food being given at each time.

Two distinct feeding periods are described, namely, the first winter and spring seasons and the autumn and second winter seasons.

Objects of the Experiment.

The objects of the experiment were threefold : —

I. To ascertain, if possible, those rations, i. e., *combinations of food, that would produce the largest growth for the least outlay of money.*

II. To secure facts relating to the actual cost of beef production in Massachusetts under existing local conditions.

III. To compare the relative merits and cost of pasture vs. *soiling during the summer season.*

1. Feeding Record of First Winter and Spring Seasons.

Dec. 1, 1891, to June 12, 1892.

[Coarse fodders: hay, corn ensilage, corn stover, green rye, turnips, mangolds and sugar beets; grains: wheat bran, Chicago maize feed and Buffalo gluten feed.]

Local Market Cost, per Ton, of the Various Articles of Fodder used.

Wheat bran,	$22 00
Chicago maize feed,	25 00
Buffalo gluten feed,	23 00
Hay,	15 00
Dent corn ensilage,*	2 50
Sweet corn ensilage,	2 50
Dent corn stover,*	5 00
Green rye,	2 50
Turnips,	2 50
Mangolds,	4 00
Sugar beets,	5 00

* Pride of the North.

Analyses of Fine Feed used.

Fodder Analyses.	Wheat Bran.	Chicago Maize Feed.	Buffalo Gluten Feed.
Moisture at 100° C.,	10.09	8.70	7.65
Dry matter,	89.91	91.30	92.35
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	6.62	0.78	0.86
" cellulose,	11.91	7.97	5.42
" fat,	4.76	7.37	13.23
" protein,	17.55	27.75	25.95
Non-nitrogenous extract matter,	59.16	56.33	54.54
	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

Fertilizing Analyses.	Wheat Bran.	Chicago Maize Feed.	Buffalo Gluten Feed.
Moisture,	10.09	8.70	7.65
Nitrogen,	2.52	4.03	3.88
Phosphoric acid,	2.85	0.30	0.30
Potassium oxide,	1.63	0.045	0.045
Valuation per 2,000 pounds,	$12 16	$12 41	$12 41
Manurial value obtainable,	11 18	11 41	11 00

Analyses of Coarse Fodders used.

Fodder Analyses.	Hay.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Dent Corn Stover.	Green Rye.	Turnips.	Mangolds.	Sugar Beets.
Moisture at 100° C.,	9.72	79.92	84.30	20.10	62.11	90.21	87.75	85.27
Dry matter,	90.28	20.08	15.70	79.90	37.89	9.79	12.25	14.73
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.								
Crude ash,	6.43	4.99	6.32	6.12	5.27	8.47	9.06	5.95
" cellulose,	32.28	27.19	29.32	33.72	21.52	11.23	7.94	6.49
" fat,	2.49	3.29	7.36	2.51	2.46	1.74	0.88	0.66
" protein,	9.54	8.29	7.86	7.75	5.38	10.12	10.37	10.97
Non-nitrogenous extract matter,	49.26	56.24	49.14	49.90	65.57	68.44	71.75	75.93
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

Fertilizer Analyses.	Hay.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Dent Corn Stover.	Green Rye.	Turnips.	Mangolds.	Sugar Beets.
Moisture,	9.72	79.92	84.30	20.11	62.11	90.21	87.75	85.27
Nitrogen,	1.38	0.27	0.20	0.99	0.327	0.178	0.203	0.26
Phosphoric acid,	0.36	0.33	0.41	1.40	0.734	0.385	0.383	0.48
Potassium oxide,	1.57	0.14	0.089	0.29	0.15	0.104	0.093	0.10
Valuation per 2,000 pounds,	$5 95	$1 26	$1 06	$4 55	$1 80	$0 99	$1 06	$1 32
Manurial value obtainable,	5 47	1 16	0 97	4 19	1 66	0 91	0 97	1 21

Average Composition of the Daily Fodder Rations used during the Seven Successive Feeding Periods.

(First Winter and Spring Seasons, 1891–92.)

I.

December 1 to December 21.

Wheat bran,	2.5 lbs.
Chicago maize feed,	2.5 "
Hay,	8 "
Turnips,	15 "
Nutritive ratio,	1:5.94
Total cost,	13.87 cts.
Manurial value obtainable,	5.44 "
Net cost,	8.43 "

II.

December 26 to January 12.

Wheat bran,	2.5 lbs.
Chicago maize feed,	2.5 "
Hay,	8 "
Mangolds,	15 "
Nutritive ratio,	1:6.06
Total cost,	14.87 cts.
Manurial value obtainable,	5.64 "
Net cost,	9.23 "

III.

January 25 to February 21.

Wheat bran,	3 lbs.
Chicago maize feed,	3 "
Dent corn ensilage,	35 "
Nutritive ratio,	1:5.4
Total cost,	11.42 cts.
Manurial value obtainable,	5.39 "
Net cost,	6.03 "

IV.

February 29 to March 22.

Wheat bran,	3 lbs.
Chicago maize feed,	3 "
Sweet corn ensilage,	47 "
Nutritive ratio,	1:5.92
Total cost,	12.92 cts.
Manurial value obtainable,	5.64 "
Net cost,	7.28 "

V.

March 28 to April 19.

Wheat bran,	3 lbs.
Chicago maize feed,	3 "
Dent corn stover,	10 "
Nutritive ratio,	1:5.65
Total cost,	9.55 cts.
Manurial value obtainable,	5.48 "
Net cost,	4.07 "

VI.

April 26 to May 20.

Wheat bran,	3 lbs.
Buffalo gluten feed,	3 "
Hay,	10 "
Sugar beets,	12 "
Nutritive ratio,	1:5.95
Total cost,	17.55 cts.
Manurial value obtainable,	6.75 "
Net cost,	10.80 "

VII.

June 1 to June 12.

Wheat bran,	3 lbs.
Buffalo gluten feed,	3 "
Green rye,	23 "
Nutritive ratio,	1:6.9
Total cost,	9.62 cts.
Manurial value obtainable,	5.33 "
Net cost,	4.29 "

Points to be Noticed in Above.

1. The actual composition of the different rations and the general proportion which the nitrogenous matter bears to the non-nitrogenous, *i.e.*, the nutritive ratio.

2. Notice how both the total and net cost of the different rations differ, and that wherever a considerable quantity of hay is fed the cost of the ration increases.

Summary of Cost of the Above-stated Average Daily Fodder Rations.

[Cents.]

	Feeding Periods.						
	I.	II.	III.	IV.	V.	VI.	VII.
Total cost,	13.87	14.87	11.42	12.92	9.55	17.55	9.62
Manurial value obtainable,*	5.44	5.64	5.39	5.64	5.48	6.75	5.33
Net cost,	8.43	9.23	6.03	7.28	4.07	10.80	4.29

* Allowing ninety-two per cent. of the fertilizing ingredients of the feed to be recovered in the manure.

Gain required per Day in Pounds of Live Weight to cover Cost of Feed.

	Feeding Periods.						
	I.	II.	III.	IV.	V.	VI.	VII.
On total cost,	3.26	3.50	2.69	3.04	2.25	4.10	2.27
On net cost,	2.00	2.17	1.42	1.71	0.96	2.54	1.00

Live Weight actually produced per Day.

	2.21	1.77	1.78	1.15	0.70	2.00	0.87

Cost of Feed per Pound of Live Weight gained.

[Cents.]

Total cost,	6.30	8.40	6.41	11.24	13.64	8.77	11.06
Net cost,	3.83	5.20	3.38	6.33	5.81	5.40	4.96

Remarks.

These figures show that in no case have the animals gained enough in live weight to cover the total cost of the food consumed, but the weight gained was nearly sufficient to cover the net cost of the feed.

Considering the merits of the different rations as far as their relative cost and productive capacity are concerned, the results are at least instructive.

Notice, first, that the larger the amount of hay fed the higher the cost of the daily ration. In this experiment, however, a moderate amount of hay in combination with roots and grains has produced beef at a fairly low price. Ration number III., consisting of ensilage and grains, has also given very favorable results. In the latter case the total cost of feed per pound of live weight gained was 6.35 cents and the net cost 3.38 cents. Many experiments have demonstrated the fact that corn ensilage, when fed in combination with concentrated feeds high in protein, produces beef at as low a cost as any other known coarse fodder article, and it proves itself an excellent fodder for winter feeding.

Steer No. 1.

Feeding Periods.	Feed consumed (Pounds) per Day.											Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).	Dry Matter required to produce One Pound of Live Weight (Pounds).
	Wheat Bran.	Chicago Maize Feed.	Buffalo Gluten Feed.	Hay.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Dent Corn Stover.	Green Rye.	Turnips.	Mangolds.	Sugar Beets.						
1891-92.																	
Dec. 1 to Dec. 21,	2.5	2.5	-	9.0	-	-	-	-	15.0	-	-	14.13	1:5.94	588	650	3.00	4.71
Dec. 26 to Jan. 12,	2.5	2.5	-	8.7	-	-	-	-	-	13.8	-	14.06	1:6.06	650	695	2.00	7.03
Jan. 25 to Feb. 21,	3.0	3.0	-	-	35.0	-	-	-	-	-	-	12.44	1:5.40	700	750	1.80	6.91
Feb. 29 to March 22,	3.0	3.0	-	-	-	44.0	-	-	-	-	-	12.34	1:5.90	750	780	1.30	9.50
March 28 to April 19,	3.0	3.0	-	-	-	-	9.0	-	-	-	-	12.64	1:5.65	774	785	0.50	25.30
April 26 to May 20,	3.0	-	3.0	10.0	-	-	-	-	-	-	12.0	16.30	1:5.95	812	860	2.00	8.15
June 1 to June 12,	3.0	-	3.0	-	-	-	-	24.0	-	-	-	14.56	1:6.90	870	885	1.25	11.64

	Pounds.
Live weight of animal at the beginning of the experiment,	588.00
Live weight of animal at the close of the experiment,	885.00
Live weight gained during the experiment,	297.00
Average gain in weight per day,	1.52

Steer No. 2.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.											Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).	Dry Matter required to produce One Pound of Live Weight (Pounds).
	Wheat Bran.	Chicago Maize Feed.	Buffalo Gluten Feed.	Hay.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Dent Corn Stover.	Green Rye.	Turnips.	Mangolds.	Sugar Beets.						
1891-92.																	
Dec. 1 to Dec. 21,	2.5	2.5	-	7.3	-	-	-	-	15.0	-	-	12.59	1:5.94	600	631	1.50	8.40
Dec. 26 to Jan. 12,	2.5	2.5	-	8.0	-	-	-	-	-	13.8	-	13.42	1:6.06	649	683	1.55	8.70
Jan. 25 to Feb. 21,	3.0	3.0	-	-	35.0	-	-	-	-	-	-	12.44	1:5.40	700	750	1.80	7.00
Feb. 29 to March 22,	3.0	3.0	-	-	-	53.0	-	-	-	-	-	13.76	1:5.92	776	800	1.00	13.76
March 28 to April 19,	3.0	3.0	-	-	-	-	9.0	-	-	-	-	12.64	1:5.65	770	792	1.00	12.64
April 26 to May 20,	3.0	-	3.0	10.0	-	-	-	-	-	-	12.0	16.30	1:5.95	825	874	2.00	8.15
June 1 to June 12,	3.0	-	3.0	-	-	-	-	22.5	-	-	-	15.02	1:6.90	865	871	0.50	30.04

	Pounds.
Live weight of animal at the beginning of the experiment,	600.00
Live weight of animal at the close of the experiment,	871.00
Live weight gained during the experiment,	271.00
Average gain in weight per day,	1.39

2. Feeding Record of Autumn and Second Winter Seasons.

Sept. 5, 1892, to Feb. 28, 1893.

[Corn fodders: green fodder corn, green serradella, corn stover and corn and soja-bean ensilage; grains: wheat bran and Buffalo gluten feed.]

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran,	$20 00
Buffalo gluten feed,	21 00
Fodder corn (green),	2 50
Serradella (green),	2 75
Corn stover,	5 00
Corn and soja-bean ensilage,	2 75

Analyses of the Various Articles of Fodder used.

Fodder Analyses.	Wheat Bran.	Buffalo Gluten Feed.	Fodder Corn.	Serradella.	Corn Stover.	Corn and Soja-bean Ensilage.
Moisture at 100° C.,	8.71	7.18	68.53	82.03	14.66	77.77
Dry matter,	91.29	92.82	31.47	17.97	85.34	22.23
	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.						
Crude ash,	7.08	0.84	5.68	9.59	5.49	9.48
" cellulose,	12.10	7.50	23.00	26.28	37.57	26.63
" fat,	5.64	12.75	2.81	2.59	1.82	3.75
" protein,	17.73	26.28	6.22	15.13	4.00	7.91
Non-nitrogenous extract matter,	57.45	52.63	62.30	46.41	51.02	52.23
	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

Fertilizer Analyses.	Wheat Bran.	Buffalo Gluten Feed.	Fodder Corn.	Serradella.	Corn Stover.	Corn and Soja-bean Ensilage.
Moisture,	8.71	7.18	68.53	82.03	14.66	77.77
Nitrogen,	2.42	4.25	0.31	0.43	0.55	0.32
Phosphoric acid,	2.85	0.30	0.05	1.26	0.23	0.12
Potassium oxide,	1.63	0.04	0.15	0.38	1.84	0.48
Valuation per 2,000 pounds,	$11 86	$13 13	$1 12	$1 78	$3 55	$1 52
Manurial value obtainable,	10 90	12 07	1 03	1 63	3 26	1 40

Average Composition of the Daily Fodder Rations used during the Four Successive Feeding Periods.

(Autumn and Second Winter Seasons, 1892–93.)

I.		II.	
September 5 to September 12.		*September 17 to September 28.*	
Wheat bran,	3 lbs.	Wheat bran,	3 lbs.
Buffalo gluten feed,	3 "	Buffalo gluten feed,	3 "
Fodder corn,	70 "	Fodder corn,	40 "
Nutritive ratio,	1 : 8.70	Serradella,	20 "
Total cost,	14.90 cts.	Nutritive ratio,	1 : 6.60
Manurial value obtainable,	7.00 "	Total cost,	13.89 cts.
Net cost,	7.90 "	Manurial value obtainable,	7.10 "
		Net cost,	6.79 "

III.		IV.	
December 1 to January 9.		*January 16 to February 28.*	
Wheat bran,	3 lbs.	Wheat bran,	4 lbs.
Buffalo gluten feed,	3 "	Buffalo gluten feed,	4 "
Corn stover,	13 "	Corn and soja-bean ensilage,	43 "
Nutritive ratio,	1 : 8.00	Nutritive ratio,	1 : 5.80
Total cost,	9.40 cts.	Total cost,	13.57 cts.
Manurial value obtainable,	5.55 "	Manurial value obtainable,	7.60 "
Net cost,	3.85 "	Net cost,	5.97 "

Summary of Cost of the Above-stated Average Daily Fodder Rations.

[Cents.]

	Feeding Periods.			
	I.	II.	III.	IV.
Total cost,	14.90	13.89	9.40	13.57
Manurial value obtainable,*	7.00	7.10	5.55	7.60
Net cost,	7.90	6.79	3.85	5.97

* Allowing ninety-two per cent. of the fertilizing ingredients of the feed to be recovered in the manure.

Gain required per Day in Pounds of Live Weight to cover Cost of Feed.

	Feeding Periods.			
	I.	II.	III.	IV.
Total cost, ...	3.50	3.27	2.21	3.19
Net cost, ...	1.86	1.60	0.91	1.40

Live Weight actually produced per Day.

	–*	–*	0.98	1.84

Cost of Feed per Pound of Live Weight gained.

[Cents.]

Total cost, ...	–	–	9.60	7.37
Net cost, ...	–	–	3.93	3.25

* Period too short to draw any conclusions.

Remarks on the Above Figures.

It again appears that the gain in live weight about covers the net cost of the food consumed.

The comparison between corn stover and corn and soja-bean ensilage is not strictly fair, for in case of ration IV. two pounds extra of grain were fed.

Notice that, while the growth was much slower when the animals were fed corn stover, yet, because of its comparative cheapness and manurial value, the net cost of beef produced was fairly low.

Ration IV., consisting of grains and corn and soja-bean ensilage, also gave very favorable results, producing beef at a net cost of 3.25 cents per pound.

Steer No. 1.

Feeding Periods.	Feed consumed (Pounds) per Day.						Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).	Dry Matter required to produce One Pound of Live Weight (Pounds).
	Wheat Bran.	Buffalo Gluten Feed.	Fodder Corn.	Serradella.	Corn Stover.	Corn and Soja-bean Ensilage.						
1892-93.												
Sept. 5 to Sept. 12, . . .	3.00	3.00	70.00	–	–	–	27.47	1:8.7	–	–	–	–
Sept. 17 to Sept. 28, . . .	3.00	3.00	40.00	20.00	–	–	21.67	1:6.6	–	–	–	–
Dec. 1 to Jan. 9, . . .	3.00	3.00	–	–	11.45	–	15.28	1:8.0	1,111	1,137.5	0.66	26.5
Jan. 24 to Feb. 28, . . .	4.00	4.00	–	–	–	43.00	16.85	1:5.8	1,180	1,255.0	2.14	7.5

	Pounds.
Live weight of animal at the beginning of the experiment, ...	1,111.00
Live weight of animal at the close of the experiment, ...	1,255.00
Live weight gained during the experiment, ...	144.00
Average gain in weight per day, ...	1.60

Steer No. 2.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.						Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).	Dry Matter required to produce One Pound of Live Weight (Pounds).
	Wheat Bran.	Buffalo Gluten Feed.	Fodder Corn.	Serradella.	Corn Stover.	Corn and Soja-bean Ensilage.						
1892-93.												
Sept. 5 to Sept. 12,	3.00	3.00	70.00	–	–	–	27.47	1:8.7	–	–	–	–
Sept. 17 to Sept. 28,	3.00	3.00	40.00	20.00	–	–	21.67	1:6.6	–	–	–	–
Dec. 1 to Jan. 9,	3.00	3.00	–	–	9.64	–	13.66	1:7.5	1,055	1,117.5	1.31	10.43
Jan. 24 to Feb. 28,	3.88	3.88	–	–	–	41.00	16.41	1:5.8	1,150	1,215.0	1.55	10.60

	Pounds.
Live weight of animal at the beginning of the experiment,	1,055.00
Live weight of animal at the close of the experiment,	1,215.00
Live weight gained during the experiment,	160.00
Average gain in weight per day,	1.78

Conclusions.

In answer to question 1: *What rations are best to produce the greatest growth for the least outlay of money?*

The experiment indicates: —

a. That those coarse fodders should be grown and fed that produce the largest amount of dry matter upon a given area; leguminous crops are especially valuable as coarse fodders.

b. Such coarse foods as corn fodder, corn ensilage, corn and soja-bean ensilage, and vetch and oats take the place of hay, and when fed in combination with concentrated nitrogenous feed stuffs, as in rations given, have produced very favorable results.

c. Animals are more than machines, — they are living beings, of so complicated a nature that they are very liable to get out of order, or, not being in the proper condition, they fail to respond to the foods fed as expected. Therefore, one experiment is not in itself sufficient to enable any one to judge with certainty as to the comparative merits of different foods, but it serves rather as a link in the chain of evidence. When the experiments in this line are completed, the combined evidence will be instrumental in pointing out lessons of permanent value.

II. THE COST OF BEEF PRODUCTION.

For a considerable time the idea has been prevalent among intelligent farmers in Massachusetts that beef production could not be carried on with profit. No extended observations have been made, however, or no accurate accounts kept that would give any facts to show at what price beef could actually be produced; and in order to answer this question, experiments have been carried on at the station for several years. The following record is presented as a result of the experiment with the two steers already described. The steers were purchased Nov. 19, 1891, at $3\frac{1}{2}$ cents per pound of live weight, and sold Feb. 28, 1893, at $4\frac{1}{4}$ cents per pound of live weight. They were not put out to pasture during the summer of 1892, but were kept in the barn or turned into the yard, and were fed a variety of green crops with grains.

Steer No. 1.

Fodder Articles.	Feed consumed (Pounds).	Dry Matter (Pounds).	Local Market Cost.	Manurial Value Obtainable.	Net Cost.
Wheat bran,	1,403	1,262.7	$14 73	$7 71	$7 02
Chicago maize feed,	389	355.0	4 86	2 21	2 65
Buffalo gluten feed,	964	892.0	10 60	5 54	5 06
Cotton-seed meal,	56	51.0	0 78	0 55	0 23
Hay,	821	741.0	6 15	2 24	3 91
Corn fodder,	2,637	831.0	3 29	1 35	1 94
Corn stover,	1,538	1,291.9	3 84	3 22	0 62
Dent corn ensilage,	1,178	235.6	1 47	0 68	0 79
Sweet corn ensilage,	1,214	190.5	1 51	0 59	0 92
Corn and soja-bean ensilage,	2,130	472.8	2 92	1 49	1 43
Green rye,	474	179.6	0 59	0 39	0 20
Peas and oats (green),	470	64.4	0 64	0 34	0 30
Vetch and oats (green),	1,160	208.8	1 59	1 04	0 55
Serradella (green),	523	95.0	0 72	0 42	0 30
Cabbages,	636	60.4	0 79	0 39	0 40
Turnips,	460	45.2	0 57	0 21	0 36
Mangolds,	306	37.3	0 61	0 15	0 46
Sugar beets,	366	53.8	0 91	0 22	0 69
Other green crops,	427	59.9	0 53	0 26	0 27
		7,127.9	$57 10	$29 00	$28 10

	Pounds.
Live weight of animal when purchased,	588
Live weight of animal when sold,	1,255
Total gain during the experiment,	667

Financial Statement.

	Debit.	Credit.
Original cost of steer, 588 pounds at $3\frac{1}{2}$ cents, . .	$20 47	
Total cost of feed, ...	57 10	
Selling price of steer, 1,255 pounds at $4\frac{1}{4}$ cents, .		$53 34
Value of manure produced, ...		29 00
	$77 57	$82 34

Total cost of feed required to produce 1 pound of live weight,	8.55 cts.
Net cost of feed required to produce 1 pound of live weight,	4.22 "
Average gain in weight per day, ...	1.43 lbs.
Dry matter required to produce 1 pound of live weight, .	10.64 "

Steer No. 2.

Fodder Articles.	Feed consumed (Pounds).	Dry Matter (Pounds).	Local Market Cost.	Manurial Value Obtainable.	Net Cost.
Wheat bran, . . .	1,350	1,214.5	$14 17	$7 42	$6 75
Chicago maize feed, .	389	354.0	4 86	2 21	2 65
Buffalo gluten feed, .	911	841.5	10 01	5 23	4 78
Cotton-seed meal, . .	56	51.0	0 78	0 55	0 23
Hay, ...	767	692.6	5 75	2 11	3 64
Corn fodder, . . .	2,638	831.0	3 29	1 35	1 94
Corn stover, . . .	1,342	1,127.3	3 35	2 81	0 54
Dent corn ensilage, .	1,169	233.8	1 46	0 68	0 78
Sweet corn ensilage, .	1,400	220.0	1 75	0 67	1 08
Corn and soja-bean ensilage, ...	2,041	453.1	2 80	1 43	1 37
Green rye, ...	474	179.6	0 59	0 39	0 20
Peas and oats (green), .	470	64.4	0 69	0 34	0 35
Vetch and oats (green), .	1,160	208.8	1 59	1 04	0 55
Serradella (green), .	483	86.9	0 66	0 39	0 27
Cabbages, . . .	635	60.4	0 79	0 39	0 40
Turnips, ...	460	45.2	0 57	0 21	0 36
Mangolds, . . .	306	37.3	0 61	0 15	0 46
Sugar beets, . . .	366	53.8	0 91	0 22	0 69
Other green crops, . .	427	59.9	0 53	0 27	0 26
		6,815.1	$55 16	$27 86	$27 30

	Pounds.
Live weight of animal when purchased, . . .	595
Live weight of animal when sold, ...	1,215
Total gain during experiment, ...	620

Financial Statement.

	Debit.	Credit.
Original cost of steer, 595 pounds, at 3½ cents, . .	$20 82	
Total cost of feed, ...	55 16	
Selling price of steer, 1,215 pounds, at 4¼ cents, .		$51 64
Value of manure produced, ...		27 57
	$75 98	$79 21

Total cost of feed required to produce 1 pound of live weight,	8.90 cts.
Net cost of feed required to produce 1 pound of live weight,	4.40 "
Average gain in weight per day, ...	1.32 lbs.
Dry matter required to produce 1 pound of live weight, .	10.99 "

Conclusions.

In answer to inquiry II. : — *The cost of beef production.*

a. The financial statement shows that, excluding the cost of labor, the coarse fodder articles and grains have been sold at market rates, and have been a trifle more than paid for in the value of the beef and of the manure produced. The value of the latter is calculated on the basis of the current market rates for nitrogen, phosphoric acid and potash.

b. Taking an average of the two steers, the total cost of producing 1 pound of live weight was 8.7 cents and the net cost 4¼ cents.

c. The average daily gain for the entire experiment (467 days) was 1.37 pounds, and the dry matter required to produce 1 pound of gain was 10.82 pounds.

d. These results are interesting, if not encouraging. The experiments are being continued, and it is hoped that in the next report the results of the work in this direction for the past four years can be presented. The results of one experiment are by no means conclusive. It is only when the average of a considerable number of experiments, in which all or nearly all give practically the same results, that the desired facts are obtained.

III. SUMMER SOILING *vs.* PASTURE.

The third object of the present steer-feeding experiment was to ascertain the relative merits of summer soiling *vs.*

pasture for growing steers. With this end in view the steers were kept in the barn during the summer or turned into the barn-yard and fed with a variety of green crops raised upon the station grounds in connection with grain. Steers 1 and 2 consumed practically the same amount of feed during this period.

Feed consumed by each Steer during Summer Soiling.

Fodder Articles.	Feed consumed (Pounds).	Local Market Cost.	Manurial Value Obtainable.	Net Cost.
Wheat bran,	454	$4 59	$2 49	$2 10
Buffalo gluten feed,	454	5 04	2 87	2 17
Hay,	232	1 74	0 63	1 11
Corn fodder,	2,372	2 96	1 22	1 74
Green rye,	474	0 59	0 39	0 20
Peas and oats (green),	470	0 69	0 33	0 36
Vetch and oats (green),	1,160	1 59	1 04	0 55
Serradella (green),	383	0 52	0 31	0 21
Cabbages,	496	0 62	0 31	0 31
Sugar beets,	240	0 60	0 16	0 44
Other green crops,	387	0 53	0 26	0 27
		$19 47	$10 01	$9 46

Summer Soiling compared with Pasture.

	Soiling.		Pasture.	
	Steer 1.	Steer 2.	Average Two Steers. 1890.	Average Three Steers. 1891.
Date of beginning experiment,	May 1.	May 1.	May 10.	April 27.
Date of ending experiment,	Sept. 30.	Sept. 30.	Sept. 30.	Nov. 3.
Number of days,	153	153	144	190
Live weight of steers at beginning of experiment,	818	827	867	828
Live weight of steers at end of experiment,	1,040	1,015	971	935
Total weight gained,	232	188	104	107
Average gain in weight per day,	1.52	1.23	0.72	0.57
Total cost of feed per day, soiling (cents),	12.72	12.72	-	-
Net cost of feed per day, soiling (cents),	6.18	6.18	-	-
Total cost of feed per day at 40 cents per week for pasture (cents),	-	-	5.71	3.57*
Total cost of feed required to produce one pound of live weight (cents),	8.39	10.35	8.24	6.36
Net cost of feed required to produce one pound of live weight (cents),	4.08	5.03	-	-

* Allowing 25 cents per week for pasture.

Comments on the results of inquiry III.

The above experiment with soiling in case of growing steers is the first tried at the station. Another experiment with three steers is under way, and will be reported later.

It will be seen from the table that: —

1. The different steers gained from two to three times as much in live weight per day when fed at home as when pastured.

2. The price paid for the pasture will in a measure govern the profit and loss of the operation.

3. The total cost of the feed required to produce one pound of live weight was approximately the same in the different experiments. In case of the three steers pastured in 1891, the cost of feed per day, 6.36 cents, was less than in the case of the soiling experiment, being due to the low price paid for the pasture.

4. In case of soiling, the net cost of feed required to produce one pound of live weight, 4 to 5 cents, proved to be about one-half the total cost. In other words, the chief gain seems to have been in the value of the manure produced.

Disadvantages of Pasture.

1. The uncertainty of the supply of food, being governed (*a*) by the weather and (*b*) by the general poor condition of the New England grazing lands.

2. The loss of the manure.

3. The loss of live weight, apparently unavoidably connected with a system of changing from stall feeding to pasturing and back again. This loss has generally amounted to from 20 to 30 pounds of live weight per animal.

4. The slowness of the gain in live weight as compared with soiling.

Advantages and Disadvantages of Soiling.

1. The experiment shows that nearly three times as much gain in live weight per day has been produced by soiling as by pasturing.

2. The chief disadvantage would be in the cost of the labor required to care for the animals during this period, and the expense in growing the green crops.

3. An advantage would be found in the greatly increased amount of fodder produced on the land in a state of cultivation.

It appears from the facts thus far shown that no absolute rule can be laid down to govern all cases. The subject, however, is worthy of the serious attention of the farmers, though local conditions and circumstances will greatly affect the decision as to which system is the more suitable for the particular locality.

III.

WINTER FEEDING EXPERIMENT WITH LAMBS.

November, 1892, to March, 1893.

The experiment about to be described is the fourth in a series designed to ascertain how best to feed the various grains and coarse fodders in order to produce the greatest live weight at the lowest possible cost.

Objects of the Experiment.

The objects of this experiment were threefold: —

I. To ascertain the economy of feeding a greater *vs.* a less quantity of protein in the daily fodder rations, *i. e.*, the old question of wide *vs.* narrow rations.

II. To see if mutton could not be produced cheaper by feeding ensilage as a part substitute for rowen, *i. e.*, to get cheaper fodder rations that would prove equally effective.

III. To ascertain what it actually costs to produce a pound of live or dressed weight.

1. General Description.

Six grade Southdown wethers were purchased Nov. 9, 1892, of Mr. G. L. Henry. Each sheep was kept in a separate pen during the entire experiment.

The average weight was about 60 pounds, and they cost 6 cents per pound. The market price at this time was $5\frac{1}{2}$ cents, but, as these animals had been on the road for several days without much food, the seller considered 6 cents a fair price. The sheep were kept in the stable for ten days, to get them accustomed to their surroundings, and were fed

during that time upon Buffalo gluten feed and soja-bean straw. They were sheared November 18, with the following results: —

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Weight before shearing, . . .	60.50	65.00	66.00	74.25	69.00	67.75
Weight after shearing, ...	56.75	60.75	62.50	70.25	65.25	64.50
Weight of wool, ...	3.75	4.25	3.50	4.00	3.75	3.25

2. Fodder Articles Fed.

The grain feed consisted of Buffalo gluten feed and cotton-seed meal of good average quality and condition.

The coarse fodder consisted of a fairly good quality of rowen and an average quality of corn and soja-bean ensilage, raised and prepared upon the station grounds.

3. Local Market Cost, per Ton, of the Various Articles of Fodder used.

Buffalo gluten feed, ...	$21 00
Cotton-seed meal, ...	28 00
Rowen, ...	15 00
Corn and soja-bean ensilage, ...	2 75

4. Mode of Feeding.

The animals were fed twice each day, about eight o'clock in the morning and at five in the afternoon, one-half the feed being given at each time. Water was offered *ad libitum*. About five grammes ($\frac{1}{6}$ ounce) of salt were fed daily, mixed with the grain.

I. TO ASCERTAIN THE ECONOMY OF FEEDING A GREATER *vs.* A LESS QUANTITY OF PROTEIN IN THE DAILY FODDER RATIONS.

The animals were divided into two lots of three each, each sheep, as before stated, being kept in a separate pen.

Lot I., consisting of sheep No. 1, No. 2 and No. 3, was fed a ration having a nutritive ratio of 1 : 4.5 during the entire experiment, which began Nov. 19, 1892, and closed March 13, 1893.

Lot II., consisting of sheep No. 4, No. 5 and No. 6, was fed a ration of 1 : 5.5 from Nov. 19, 1892, till Feb. 15, 1893,

when the ratio was changed to 1 : 4 5, and so continued till March 13, 1893.

Both lots received approximately the same amount of digestible organic matter.

Analyses of the Various Articles of Fodder used.

FODDER ANALYSES.	Buffalo Gluten Feed.	Cotton-seed Meal	Rowen.	Corn and Soja-bean Ensilage.
Moisture at 100° C.,	7.18	6.20	11.30	77.77
Dry matter,	92.82	93.80	88.70	22.23
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	0.84	7.37	6.48	9.48
" cellulose,	7.50	5.81	29.98	26.63
" fat,	12.75	13.04	4.23	3.75
" protein,	26.28	44.71	12.11	7.91
Non-nitrogenous extract matter,	52.63	28.57	47.20	52.23
	100.00	100.00	100 00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Buffalo Gluten Feed.	Cotton-seed Meal.	Rowen.	Corn and Soja-bean Ensilage.
Moisture,	7.18	6.20	11.30	77.77
Nitrogen,	4.25	7.15	1.94	0.32
Phosphoric acid,	0.30	2.33	0.46	0.12
Potassium oxide,	0.04	1.72	1.97	0.48
Valuation per 2,000 pounds,	$13 13	$25 56	$8 10	$1 52
Manurial value obtainable,	12 07	23 57	7 45	1 40

Average Composition of the Daily Fodder Rations used during the Successive Feeding Periods.

Lot I.

I.		II.	
November 19 to November 30.		*December 1 to January 9.*	
Buffalo gluten feed,	0.62 lbs.	Buffalo gluten feed,	0.87 lbs.
Cotton-seed meal,	0.12 "	Cotton-seed meal,	0 20 "
Rowen,	1.25 "	Rowen,	1.75 "
Nutritive ratio,	1 : 4.5	Nutritive ratio,	1 : 4.6
Total cost,	1.76 cts.	Total cost,	2.50 cts.
Manurial value obtainable,	0.97 "	Manurial value obtainable,	1.39 "
Net cost,	0.79 "	Net cost,	1.11 "

III.	
January 24 to March 17	
Buffalo gluten feed,	0.87 lbs.
Cotton-seed meal,	0.20 "
Rowen,	0.50 "
Corn and soja-bean ensilage,	3.00 "
Nutritive ratio,	1 : 4.7
Total cost,	1.97 cts.
Manurial value obtainable,	1.15 "
Net cost,	0.82 "

Lot II.

I.		II.	
November 19 to November 30.		*December 1 to January 9.*	
Buffalo gluten feed,	0.50 lbs.	Buffalo gluten feed,	0.62 lbs.
Rowen,	1.75 "	Rowen,	2.00 "
Nutritive ratio,	1 : 5.5	Nutritive ratio,	1 : 5.5
Total cost,	1.81 cts.	Total cost,	2.15 cts.
Manurial value obtainable,	0.95 "	Manurial value obtainable,	1.11 "
Net cost,	0.86 "	Net cost,	1.04 "

III.		IV.	
January 24 to February 15.		*February 20 to March 7.*	
Buffalo gluten feed,	0.62 lbs.	Buffalo gluten feed,	0 90 lbs.
Cotton-seed meal,	0.12 "	Cotton-seed meal,	0 20 "
Rowen,	0.50 "	Rowen,	0.50 "
Corn and soja-bean ensilage,	4.50 "	Corn and soja-bean ensilage,	3.00 "
Nutritive ratio,	1 : 5.7	Nutritive ratio,	1 : 4.7
Total cost,	1.78 cts.	Total cost,	1.97 cts.
Manurial value obtainable,	1.01 "	Manurial value obtainable,	1.15 "
Net cost,	0.77 "	Net cost,	0.82 "

Digestible Matter in the Above Rations.

[Ounces.]

	Feeding Periods.						
	Lot I.			Lot II.			
	I.	II.	III.	I.	II.	III.	IV.
Protein,	–	5.40	4.66	–	4.16	3.82	4.66
Fat,	–	2.05	2.18	–	1.48	1.86	2.18
Carbo-hydrates,	–	19.91	16.49	–	19.08	17.00	16.49
Total,	–	27.36	23.33	–	24.72	22.68	23.33

It will be noticed that Lot I. was fed with one exception more protein than Lot II., thus giving the narrow ration. The total amount of digestible organic matter, however, remained essentially the same during each parallel period. During the second feeding period both lots consumed more feed daily than at any other time.

Summary of Cost of the Above-stated Average Daily Fodder Rations.

[Cents.]

	Feeding Periods.						
	Lot I.			Lot II.			
	I.	II.	III.	I.	II.	III.	IV.
Total cost,	1.76	2.50	1.97	1.81	2.15	1.78	1.97
Manurial value obtainable,*	0.97	1.39	1.10	0.95	1.11	1.01	1.15
Net cost,	0.79	1.11	0.87	0.86	1.04	0.77	0.82

* Allowing ninety-two per cent. of the fertilizing ingredients of the feed to be recovered in the manure.

Comparisons of Lot I. (Ratio 1 : 4.5) with Lot II. (Ratio 1 : 5.5).

	Lot I.	Lot II.
	Weight.	Weight.
Beginning of experiment, November 19, . .	180.0 lbs.	200.0 lbs.
Close of experiment, February 14, . . .	252.5 "	267.0 "
Gain during experiment, ...	72.5 "	67.0* "

The next step would be to inquire into the cost of feed consumed by Lots I. and II., thus ascertaining the cost per pound of live weight gained.

	Lot I.				Lot II.			
	Buffalo Gluten Feed.	Cotton-seed Meal.	Rowen.	Corn and Soja-bean Ensilage.	Buffalo Gluten Feed.	Cotton-seed Meal.	Rowen.	Corn and Soja-bean Ensilage.
Feed consumed (pounds), .	214.40	44.00	303.25	236.00	165.30	9.37	345.25	364.75
Total cost, ...	$2 25	$0 62	$2 27	$0 32	$1 74	$0 13	$2 59	$0 50
Manurial value obtainable, .	1 29	0 52	1 12	0 17	0 99	0 11	1 28	0 26
Net cost, ...	0 96	0 10	1 15	0 15	0 75	0 02	1 31	0 24

	Lot I.	Lot II.
Live weight gained during experiment, . .	72.5 lbs.	67.0 lbs.
Total cost of feed, ...	$5 46	$4 96
Net cost of feed, ...	2 36	2 32
Total cost of feed per pound of live weight gained,	7.53 cts.	7.42 cts.
Net cost of feed per pound of live weight gained,	3.25 "	3.48 "

* Sheep No. 6, in Lot II., suffered from a severe cold during practically the entire month of December, and, consequently, did not eat as well nor gain as rapidly as the other two in this lot. Had No. 6 made the same average growth as sheep No. 4 and No. 5, the gain in live weight in Lots I. and II. would have been practically identical.

SUMMARY.

Lot I., narrow ration, 1 : 4.5.

Lot II., wider ration, 1 : 5.5.

Length of experiment, 88 days.

In answer to question I. viz., the economy of feeding rations with a nutritive ratio of 1 : 5.5 *vs.* one with a nutritive ratio of 1 : 4.5, the experiment gives the following : —

1. The gain in live weight is somewhat in favor of Lot I., to which more protein was fed.

2. The total cost of producing one pound of live weight with Lot I. was 7.53 cents and with Lot II. 7.42 cents, while the net cost with Lot I. was 3.25 cents, a little lower than with Lot II., which was 3.48 cents.

3. The results of the experiment are practically identical in case of both lots. Had sheep No. 6 been in good health during December, and made the same relative gain as No. 4 and No. 5, the results would have been rather in favor of Lot II.

4. Sheep Nos. 4 and 5 were not slaughtered. Sheep No. 3 was the fattest, No. 6 next, then came No. 1 and lastly No. 2. These results give no positive information, but would indicate in this case that the constitutional tendency of the animal, rather than the feed consumed, governed the amount of fat and flesh produced.

THE SITUATION BRIEFLY STATED.

This experiment would indicate, and it is borne out by the majority of other experiments made with reference to this point, that for the production of lean and fat in case of growing animals a ratio of 1 : 5 to 1 : 5.5 is about as economical a one as can be fed.

In order to get more definite light upon this matter, one must await the results of the carefully conducted experiments with the so-called respiration apparatus now in progress, or a large number of animals must be experimented with, and the average results taken.

It is certainly true that the constitution of the animal, no less than the quantity and proportion in which the different food components are fed, exerts a decided influence upon the production of both lean meat and fat. Experiments, there-

fore, after the manner of the one previously described, must be conducted with a large number of sheep, in order to eliminate as far as possible this source of error, and furnish data that will throw more definite light upon the subject. It is held by many who have good grounds upon which to base their belief that rations with a ratio of 1 : 4 can be economically fed.

OBJECT II. TO SEE IF LIVE WEIGHT COULD NOT BE PRODUCED CHEAPER BY SUBSTITUTING CORN AND SOJA-BEAN ENSILAGE TO A CONSIDERABLE EXTENT FOR ROWEN.

Feeding Period I. The six sheep used in the experiment were fed for seven weeks upon Buffalo gluten feed, cotton-seed meal and rowen.

Feeding Period II. In this period corn and soja-bean ensilage was substituted for the larger part of the rowen.

The following table gives the amounts of the several foods consumed and the total and net cost of the same, as well as the total and net cost of feed required to produce one pound of live weight.

	Feeding Period I.				Feeding Period II.				
	Buffalo Gluten Feed.	Cotton-seed Meal.	Rowen.	Dry Matter.	Buffalo Gluten Feed.	Cotton-seed Meal.	Rowen.	Corn and Soja-bean Ensilage.	Dry Matter.
Feed consumed (pounds),	204.25	24.75	497.50	653.74	245.25	54.56	150.00	826.50	595.00
Total cost, ...	$2 14	$0 35	$3 75	–	$2 57	$0 76	$1 12	$1 13	–
Manurial value obtainable,	1 22	0 29	1 84	–	1 47	0 64	0 55	0 58	–
Net cost, ...	0 92	0 06	1 91	–	1 10	0 12	0 57	0 55	–

	Feeding Period I.	Feeding Period II.
Weight at the beginning of the experiment, .	380.00 lbs.	485.75 lbs.
Weight at the end of the experiment, . .	461.50 "	565.00 "
Gain in weight during experiment, . .	81.50 "	79.25 "
Total cost of feed, ...	$6 26	$5 58
Net cost of feed, ...	2 89	2 34
Total cost of feed per pound of live weight gained, ...	7.68 cts.	7.04 cts.
Net cost of feed per pound of live weight gained, ...	3.55 "	2.95 "
Dry matter required to produce 1 pound of live weight, ...	8.00 "	7.51 "

Answer to Object II.

The result of the experiment is in favor of the corn and soja-bean ensilage as a substitute for a larger part of the rowen.

The total and net cost of feed required to produce one pound of live weight in Feeding Period I. was 7.68 cents and 3.55 cents, while in Feeding Period II. it was but 7.04 cents and 2.95 cents.

The dry matter required to produce one pound of live weight was also somewhat less in Feeding Period II. This answer coincides with many other experiments made at this station, and shows that in order to produce beef or mutton at the lowest cost cheap fodders must be fed in place of costly hay. Well-made corn ensilage proves a very excellent and economical substitute.

OBJECT III. TO ASCERTAIN, IN THE CASE OF GROWING LAMBS, WHAT IT COSTS TO PRODUCE ONE POUND OF LIVE OR DRESSED WEIGHT.

While this question has been in a measure answered under II., still, it is well to make a complete financial statement of the experiment. The feeding experiment proper began on Nov. 19, 1892. The sheep were sheared on the day previous. They were fed till March 13, 1893, upon which date they were again sheared, and sold at 11 cents per pound of dressed weight.

Live Weight gained during the Experiment (115 Days).

[Pounds.]

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Beginning of experiment,	56.75	60.75	62.50	70.25	65.25	64.50
End of experiment,	95.50	87.75	93.50	102.00	96.50	89.75
Gain during experiment,	38.75	27.00	31.00	31.75	31.25	25.25

Yield of Wool and Dressed Weight.

[Pounds.]

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Yield of wool at beginning of experiment, ...	3.75	4.25	3.50	4.00	3.75	3.25
Yield of wool during experiment (115 days), . .	3.00	3.00	2.13	–*	–*	2.75
Yield of dressed weight, .	48.50	43.75	48.25	–	–	45.25

* Retained for further experiments.

Feed consumed.

	Total Cost.	Manurial Value Obtainable.	Net Cost.
525.0 pounds Buffalo gluten feed, . .	$5 51	$3 15	$2 36
87.3 pounds cotton-seed meal, . .	1 22	1 02	0 20
730.0 pounds rowen, ...	5 47	2 70	2 77
1,449.0 pounds corn and soja-bean ensilage,	1 99	1 01	0 98
	$14 19	$7 88	$6 31

Average Results.

Total weight at the beginning of the experiment (sheared), 380.00 lbs.
Total weight at the end of the experiment, ... 565.00 "
Total gain in live weight, ... 185.00 "
Average gain per sheep in live weight per day (115 days), . 0.27 "
Average shrinkage (four sheep) in dressing, . . . 49.32 "
Total cost of feed per pound of live weight gained, . . 7.67 cts.
Total cost of feed per pound of dressed weight gained, . 15.13 "
Net cost of feed per pound of live weight gained, . . 3.41 "
Net cost of feed per pound of dressed weight gained, . . 6.70 "

Financial Statement.

	Debit.	Credit.
402.50 pounds live weight, at $5\frac{1}{2}$ cents, . .	$22 14	–
Cost of feed, ...	14 19	–
283.60 * pounds dressed weight, at 11 cents, . .	–	$31 20
39.38 pounds of wool, at 21 cents, . . .	–	8 27
Value of manure produced, ...	–	7 68
	$36 33	$47 15
Balance in favor of credit, ...	$10 82	–

* Assuming that Nos. 4 and 5 would shrink the same amount in dressing as Nos. 1, 2, 3 and 6.

Answer to Object III.

The results show (*a*) that the average total cost of feed required to produce one pound of live weight, on the retail price of coarse fodders and grains, as previously stated, was 7.67 cents, and the net cost 3.41 cents; the total cost per pound of dressed weight was 15.13 cents and the net cost 6.94 cents.

(*b*) The profit and loss account shows that the financial advantages of feeding yearlings during the winter are to be found, first, in selling the coarse fodder articles at a fair retail price; and, second, in the value of the manure produced. It also makes this fact very emphatic, viz., that the manure, solid as well as liquid, should be carefully guarded from any loss. The manure is valuable chiefly for the nitrogen, phosphoric acid and potash it contains, as these ingredients cost respectively 15 cents, $5\frac{1}{2}$ cents and $4\frac{1}{2}$ cents per pound in the markets. The manure, reckoned on this basis, has been found to be equal to one-half the cost of the feed consumed.

Detailed Record of Each Sheep.

Sheep No. 1.

Feeding Periods.	Feed consumed (Pounds) per Day. Buffalo Gluten Feed.	Cotton-seed Meal.	Rowen.	Corn and Soja-bean Ensilage.	Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Total Gain in Live Weight (Pounds).
1892-93.									
Nov. 19 to Jan. 10,	0.79	0.16	1.53	–	2.24	1:4.5	0.375	5.97	19.50
Jan. 24 to March 14,	0.87	0.20	0.50	2.81	2.06	1:4.6	0.224	9.22	10.95

Total Amount of Feed consumed from Nov. 19, 1892, to March 14, 1893.

	Dry Matter.	Total Cost.	Manurial Value Obtainable.	Net Cost.
94.48 pounds Buffalo gluten feed, .	87.68	$0 99	$0 56	$0 43
20.02 pounds cotton-seed meal, .	18.77	0 28	0 23	0 05
112.56 pounds rowen, . . .	99.84	0 84	0 36	0 48
171.69 pounds corn and soja-bean ensilage, ...	39.17	0 23	0 10	0 13
	245.46	$2 34	$1 25	$1 09

Live weight of animal at the beginning of the experiment,	56.75	lbs.
Live weight of animal at the end of the experiment, . .	92.50	"
Live weight gained during the experiment, . . .	35.75	"
Average gain in weight per day, ...	0.31	"
Dressed weight of animal, ...	48.50	"
Loss in weight by dressing, 47.56 per cent., . . .	44.00	"
Pounds of dry matter fed produced 1 pound of live weight,	6.86 *	"
Total cost of feed per pound of live weight gained, . .	6.54	cts.
Net cost of feed per pound of live weight gained, . .	3.05	"

* Exclusive of wool.

Sheep No. 2.

Feeding Periods.	Feed consumed (Pounds) per Day. Buffalo Gluten Feed.	Cotton-seed Meal.	Rowen.	Corn and Soja-bean Ensilage.	Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Total Gain in Live Weight (Pounds).
1892-93.									
Nov. 19 to Jan. 10, .	0.78	0.16	1.57	-	2.26	1:4.5	0.279	8.10	14.50
Jan. 24 to March 14,	0.87	0.20	0.50	2.13	1.91	1:4.4	0.189	10.12	9.25

Total Amount of Feed consumed from Nov. 19, 1892, to March 14, 1893.

	Dry Matter.	Total Cost.	Manurial Value Obtainable.	Net Cost.
93.44 pounds Buffalo gluten feed,	86.73	$0 99	$0 56	$0 43
20.06 pounds cotton-seed meal, .	18.77	0 28	0 22	0 06
114.64 pounds rowen, . . .	100.68	0 86	0 37	0 49
135.62 pounds corn and soja-bean ensilage, ...	30.15	0 19	0 08	0 11
	236.33	$2 32	$1 23	$1 09

Live weight of animal at the beginning of the experiment,	60.75 lbs.
Live weight of animal at the end of the experiment, . .	84.75 "
Live weight gained during the experiment, ...	24.00 "
Average gain in weight per day, ...	0.21 "
Dressed weight of animal, ...	43.75 "
Loss in weight by dressing, 48.37 per cent., ...	41.00 "
Pounds of dry matter fed produced 1 pound of live weight, .	9.84 "
Total cost of feed per pound of live weight gained, . .	9.66 cts.
Net cost of feed per pound of live weight gained, . .	4.54 "

Sheep No. 3.

Feeding Periods.	Feed consumed (Pounds) per Day. Buffalo Gluten Feed.	Cotton-seed Meal.	Rowen.	Corn and Soja-bean Ensilage.	Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Total Gain in Live Weight (Pounds).
1892-93.									
Nov. 19 to Jan. 10, .	0.81	0.16	1.51	–	2.25	1:4.5	0.317	7.09	16.50
Jan. 24 to March 14,	0.87	0.20	0.50	2.68	2.03	1:4.5	0.214	9.47	10.50

Total Amount of Feed consumed from Nov. 19, 1892, to March 14, 1893.

	Dry Matter.	Total Cost.	Manurial Value Obtainable.	Net Cost.
95.00 pounds Buffalo gluten feed, .	87.17	$0 99	$0 56	$0 43
20.54 pounds cotton-seed meal, .	19.26	0 29	0 24	0 05
111.52 pounds rowen, . . .	98.92	0 83	0 36	0 47
164.22 pounds corn and soja-bean ensilage, ...	36.50	0 22	0 10	0 12
	241.85	$2 33	$1 26	$1 07

Live weight of animal at the beginning of the experiment, . 62.50 lbs.
Live weight of animal at the end of the experiment, . . 91.50 "
Live weight gained during the experiment, ... 29.00 "
Average gain in weight per day, ... 0.25 "
Dressed weight of animal, ... 48.25 "
Loss in weight by dressing, 47.26 per cent., ... 43.25 "
Pounds of dry matter fed produced 1 pound of live weight, . 8.54 "
Total cost of feed per pound of live weight gained, . . 8.03 cts.
Net cost of feed per pound of live weight gained, . . . 3.70 "

Sheep No. 4.

Feeding Periods.	Feed consumed (Pounds) per Day. Buffalo Gluten Feed.	Cotton-seed Meal.	Rowen.	Corn and Soja-bean Ensilage.	Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Total Gain in Live Weight (Pounds).
1892-93.									
Nov. 19 to Jan. 10, .	0.60	–	1.88	–	2.22	1:5.5	0.298	7.45	15.50
Jan. 24 to Feb. 15, .	0.534	0.125	0.50	3.79	1.90	1:5.6	0.250	7.60	5.50
Feb. 15 to March 14,	0.875	0.20	0.50	2.96	2.10	1:4.7	0.324	6.93	8.75

Total Amount of Feed consumed from Nov. 19, 1892, to March 14, 1893.

	Dry Matter.	Total Cost.	Manurial Value Obtainable.	Net Cost.
76.07 pounds Buffalo gluten feed, .	70.60	$0 79	$0 46	$0 33
8.52 pounds cotton-seed meal, .	7.98	0 11	0 09	0 02
129.76 pounds rowen, . . .	115.10	0 97	0 41	0 56
211.80 pounds corn and soja-bean ensilage, ...	47.08	0 30	0 12	0 18
	247.76	$2 17	$1 08	$1 09

Live weight of animal at the beginning of the experiment, . 70.25 lbs.
Live weight of animal at the end of the experiment, . . 99.00 "
Live weight gained during the experiment, ... 28.75 "
Average gain in weight per day, ... 0.25 "
Dressed weight of animal, ... –
Loss in weight by dressing, ... –
Pounds of dry matter fed produced 1 pound of live weight, . 8.37 "
Total cost of feed per pound of live weight gained, . . 7.54 cts.
Net cost of feed per pound of live weight gained, . . 3.78 "

Sheep No. 5.

Feeding Periods.	Feed consumed (Pounds) per Day. Buffalo Gluten Feed.	Cotton-seed Meal.	Rowen.	Corn and Soja-bean Ensilage.	Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Total Gain in Live Weight (Pounds).
1892-93.									
Nov. 19 to Jan. 10, .	0.60	–	1.96	–	2.29	1:5.5	0.332	6.90	17.25
Jan. 24 to Feb. 15, .	0.534	0.125	0.50	3.48	1.83	1:5.5	0.318	5.75	7.00
Feb. 15 to March 14,	0.875	0.20	0.50	2.55	2.01	1:4.6	0.213	9.44	5.75

Total Amount of Feed consumed from Nov. 19, 1892, to March 14, 1893.

	Dry Matter.	Total Cost.	Manurial Value Obtainable.	Net Cost.
76.07 pounds Buffalo gluten feed, .	70.60	$0 80	$0 45	$0 35
8.52 pounds cotton-seed meal, .	7.98	0 11	0 09	0 02
133.92 pounds rowen, . . .	118.79	1 00	0 42	0 58
211.66 pounds corn and soja-bean ensilage, ...	47.05	0 29	0 73	0 16
	244.42	$2 20	$1 09	$1 11

Live weight of animal at the beginning of the experiment, . 65.25 lbs.
Live weight of animal at the end of the experiment, . . 93.50 "
Live weight gained during the experiment, ... 28.25 "
Average gain in weight per day, ... 0.25 "
Dressed weight of animal, ... –
Loss in weight by dressing, ... –
Pounds of dry matter fed produced 1 pound of live weight, . 8.65 "
Total cost of feed per pound of live weight gained, . . 7.78 cts.
Net cost of feed per pound of live weight gained, . . . 3.93 "

Sheep No. 6.

Feeding Periods.	Feed consumed (Pounds) per Day. Buffalo Gluten Feed.	Cotton-seed Meal.	Rowen.	Corn and Soja-bean Ensilage.	Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Total Gain in Live Weight (Pounds).
1892-93.									
Nov. 19 to Jan. 10, .	0.57	–	1.68	–	2.01	1:5.4	0.202	9.95	10.50
Jan. 24 to Feb. 15, .	0.534	0.125	0.50	3.83	1.90	1:5.6	0.193	9.83	4.25
Feb. 15 to March 24,	0.875	0.20	0.50	2.61	2.02	1:4.6	0.148	13.63	4.00

Total Amount of Feed consumed from Nov. 19, 1892, to March 14, 1893.

	Dry Matter.	Total Cost.	Manurial Value Obtainable.	Net Cost.
74.51 pounds Buffalo gluten feed, .	69.14	$0 78	$0 45	$0 33
8.52 pounds cotton-seed meal, .	7.98	0 11	0 09	0 02
119.36 pounds rowen, . . .	104.88	0 90	0 38	0 52
198.23 pounds corn and soja-bean ensilage, ...	45.39	0 28	0 12	0 16
	227.39	$2 07	$1 04	$1 03

Live weight of animal at the beginning of the experiment,	64.50 lbs.
Live weight of animal at the end of the experiment, . .	87.00 "
Live weight gained during the experiment, ...	22.50 "
Average gain in weight per day, ...	0.195 "
Dressed weight of animal, ...	45.25 "
Loss in weight by dressing, 47.93 per cent., ...	41.75 "
Pounds of dry matter fed produced 1 pound of live weight, .	10.11 "
Total cost of feed per pound of live weight gained, . .	9.20 cts.
Net cost of feed per pound of live weight gained, . .	4.58 "

GENERAL SUMMARY OF FEEDING EXPERIMENTS WITH GROWING LAMBS.

1890–93.

A series of winter feeding experiments has been carried on at the station during the past four years, 1890–93, with lambs born the previous spring.

Many spring lambs are not far enough advanced to be sold during the late summer at good prices, and are therefore fed during the fall and winter and placed in the market in the early spring.

These experiments have sought, among other things, to ascertain: —

I. (1) The average cost of feed to produce a pound of live weight.

(2) The average daily gain in live weight.

(3) The loss of weight in dressing.

(4) The dry matter required to produce a pound of live weight.

II. The effect of wide *vs.* narrow fodder rations on the gain in weight.

III. The combinations of grains and coarse fodder articles best suited to the economical production of lambs for the market.

Eighteen sheep were used in the three experiments presented. The experiment conducted in 1892 is excluded, from the fact that the results are so different from those of the other three years. The time occupied by the different experiments varied from 120 to 200 days.

The object here is simply to present a very brief *résumé* of the results, referring the reader to the respective annual reports for details.

1. *Cost of Production.*

[Cents.]

	1890.	1891.	1893.	Average.
Total cost of feed to produce one pound live weight,	12.25	11.03	7.67	10.32
Net cost of feed to produce one pound live weight,	6.19	6.31	3.41	5.30

2. *Average Gain.*

[Pounds]

Average daily gain in live weight,	0.19	0.21	0.27	0.22

3. *Shrinkage.*

[Per Cent]

Loss in weight by dressing,	45.3	49.9	49.3	48.2

4. *Dry Matter.*

[Pounds]

Dry matter required to produce one pound live weight,	13.61	10.04	7.75	10.47

II. Wide *vs.* narrow rations. During the years 1890 and 1891 the effect of feeding wide and narrow rations was tried. The wide rations contained less protein and more carbohydrates than the narrow ones.

The wide rations had a nutritive ratio of 1 : 6.84 and the narrow rations of 1 : 4.71.

The six sheep were divided into two lots of three each.

	Nutritive Ratio.	Average Gain in Live Weight per Day (Pounds).	Total Cost of Feed per Pound Live Weight gained (Cents).	Net Cost of Feed per Pound Live Weight gained (Cents).	Dry Matter required to produce One Pound Live Weight (Pounds).
Lot I., narrow ration,	1 : 4.71	0.22	11.30	5.51	11.35
Lot II., wide ration,	1 : 6.84	0.18	11.26	6.49	11.40

The cost of production of live weight is the same in each case. The narrow rations give a better quality of manure, and cause a somewhat increased growth.

III. *Winter Fodder Rations for Growing Lambs (60 to 100 Pounds).*

The following combinations of grains and coarse fodder have proved valuable as winter fodder rations for lambs (yearlings).

In general, where corn ensilage has been substituted for one-half to two-thirds of the rowen the growth has been fully as good and the cost of production of live weight somewhat less.

I.		II.	
Wheat bran,	0.50 lbs.	Wheat bran,	0.50 lbs.
Chicago gluten meal,	0.50 "	Chicago gluten meal,	0.50 "
Rowen,	2.00 "	Rowen,	1.00 "
Nutritive ratio,	1:4.50	Corn ensilage,	3.50 "
Total cost (approximate),	2.50 cts.	Nutritive ratio,	1:5.09
Manurial value obtainable,	1.15 "	Total cost (approximate),	2.24 cts.
Net cost,	1.36 "	Manurial value obtainable,	1.10 "
		Net cost,	1.14 "

III.		IV.	
Wheat bran,	0.50 lbs.	Wheat bran,	0.50 lbs.
Linseed meal,	0.25 "	Linseed meal,	0 25 "
Rowen,	1.50 "	Rowen,	0.50 "
Nutritive ratio,	1:4.0	Corn ensilage,	3.50 "
Total cost (approximate),	2.08 cts.	Nutritive ratio,	1:5.0
Manurial value obtainable,	1.02 "	Total cost (approximate),	1.8 cts.
Net cost,	1.06 "	Manurial value obtainable,	0.9 "
		Net cost,	0.9 "

V.		VI.	
Corn meal,	0.50 lbs.	Buffalo gluten feed,	0 75 lbs.
Cotton-seed meal,	0.50 "	Rowen,	2.00 "
Rowen,	1.50 "	Nutritive ratio,	1:5.3
Nutritive ratio,	1:5.3	Total cost (approximate),	2.33 cts.
Total cost (approximate),	2 40 cts.	Manurial value obtainable,	1.25 "
Manurial value obtainable,	1 30 "	Net cost,	1.07 "
Net cost,	1.10 "		

VII.	
Buffalo gluten feed,	0.75 lbs.
Cotton-seed meal,	0.25 "
Rowen,	0.50 "
Corn ensilage,	4.00 "
Nutritive ratio,	1:4.6
Total cost (approximate),	2.04 cts.
Manurial value obtainable,	1.14 "
Net cost,	0.90 "

Remarks on Above Rations.

Linseed meal, cotton-seed meal and Chicago gluten meal can be substituted one for the other without very materially changing the cost of the ration or its feeding effect. Buffalo gluten feed and Chicago maize feed can also be used interchangeably.

One-half pound of rowen and four to five pounds of corn ensilage in a ration tends to cheapen the cost and is as effective in feeding value as one and one-half to two pounds of rowen. In general, four pounds of corn ensilage can be reckoned an equivalent for one pound of rowen, so far as dry matter is concerned.

The rations as given can be increased or decreased proportionately in quantity to suit the appetite and size of the animals fed.

General Conclusions.

The results of the three experiments during the years 1890, 1891 and 1893 with growing lambs have shown: —

1. That the average total cost of feed required to produce one pound of live weight was 10.32 cents and the net cost 5.34 cents. The selling price of live weight during these years was 6 cents per pound.

The same facts seem to hold good with sheep as with steers, viz., the coarse fodders and grains can be sold at market rates and paid for in the value of the live weight produced, and in the value of the nitrogen, phosphoric acid and potash in the manure at the current market prices for these articles.

This experiment and many others made at the station make the following point very emphatic: since the manure produced, both solid and liquid, figures so prominently in the financial results, it is extremely important that it should be carefully preserved.

2. Narrow rations, 1 : 4.7 (with a larger amount of digestible protein than the wide rations), have produced a greater gain in live weight than wide rations, 1 : 7.0.

3. The total cost of feed required to produce one pound of live weight was about the same in each case, namely, 11.30

cents and 11.26 cents per day. The net cost in case of narrow rations was 5.51 cents per day, against 6.49 cents per day for wider rations. This shows that the chief advantage of the very narrow rations in these experiments came from the increased value of the manure produced.

4. The dry matter required to produce one pound of live weight was about the same in both cases, namely, 11.35 and 11.40 pounds. With the present knowledge of animal nutrition, rations with a nutritive ratio of about 1 : 5 appear to be the most economical to feed to growing lambs, as well as to steers.

IV.

FEEDING EXPERIMENTS WITH PIGS (TWO).

Eighteenth Experiment.

The following experiment is a continuation of those described in previous reports of the station. In our experiments with milch cows we have had considerable quantities of skim-milk remaining after the removal of the cream, and the question has ever been as to how this milk shall be disposed of *to the best advantage.* This question is one that confronts many of the farmers of our State, from the fact that the creamery system is so generally introduced. Some farmers living near large towns have opportunity to dispose of this milk at from one to two cents per quart, and it is undoubtedly more profitable to thus dispose of it than to feed it to our farm animals. Still, to by far the larger number of farmers this opportunity does not present itself, and the milk must be utilized upon the farm by feeding it to pigs or other animals.

Object of This Experiment.

The results of our previous experiments have shown that the various grains, such as corn meal, wheat bran, gluten meal and maize feed, when fed in connection with skim-milk, have furnished very excellent and profitable rations for growing young pigs for the market. The object of this experiment has been, among other things, to learn the value of Buffalo gluten feed and corn meal when fed in connection with skim-milk for the economical production of pork for the market.

The skim-milk being a very nitrogenous article of food, with a nutritive ratio of 1 to 2.15, the rations furnished the

pigs were what might be termed narrow, varying from 1 : 3.3 to 1 : 5. Whether a narrow or a wide ration is better for growing and fattening pigs is still a matter of some dispute among investigators. It is certain, however, that the rations fed in our various experiments with pigs have been productive of most excellent results, and we can commend them to the serious attention of the farmers of the State.

Description of the Experiment.

Six grade Chester White pigs, three sows and three barrows, weighing from 25 to 30 pounds each, served us for the experiment. They were kept in separate pens, and fed three times per day, namely, in the morning at six o'clock, at noon, and in the afternoon at five o'clock, with all the food they would eat up clean. It was always our object to supply them plentifully, but at the same time not to glut them, and thus in a measure destroy their appetites.

The liquid food consisted of from three to six quarts of skim-milk per day, depending upon the size of the pigs and the quantity of milk at our disposal. It never exceeded six quarts per day. The grain fed was corn meal and Buffalo gluten feed. The gluten feed, being quite rich in protein, served to keep our rations within the limits desired when the supply of skim-milk failed, and four ounces of gluten feed was in a general way reckoned equal to one quart of skim-milk.

Number of Feeding Periods.

The experiment was divided into three distinct feeding periods. The first period continued till the pigs reached 80 pounds in weight, and the food consisted of two ounces of corn meal to every quart of milk, with a ratio of 1 : 3.3. As our supply of milk at this season was rather limited, four ounces of gluten feed was substituted for each quart of milk, and this gradually increased the ratio to 1 : 4.

The second period began when the pigs reached about 80 pounds in weight and continued till 125 pounds weight was reached. The food consisted of the skim-milk at our disposal, which varied somewhat, together with corn meal and Buffalo gluten feed, to give the desired ratio of 1 : 4.5.

The third and last period began when the pigs weighed 125 pounds and ended when 180 pounds was reached, at which time they were slaughtered. The feed consisted of skim-milk, and of a mixture of one and one-half parts corn meal and one part Buffalo gluten feed, fed in sufficient quantities to satisfy the appetite of the animals.

The following tables will, we believe, present sufficient data to enable the reader to understand the experiment and grasp the results obtained : —

Feeding Periods.	Composition of Ration.	Duration of Period.	Nutritive Ratio.
Period I., .	2 ounces corn meal to each quart milk, .	20 to 80 pounds live weight.	1:3.3
Period II., .	4 ounces corn meal to each quart milk, and 4 ounces Buffalo gluten feed as a substitute for quart milk.	80 to 125 pounds live weight.	1:4.5
Period III.,	4 to 6 quarts milk and 1½ parts corn meal to 1 part Buffalo gluten feed to satisfy animal.	125 to 180 pounds live weight.	1:4.9

		Average Daily Rations.					
		Skim-milk (Quarts).	Corn Meal (Ounces).	Gluten Feed (Ounces).	Nutritive Ratio.	Average Weekly Weight (Pounds).	Average Daily Gain (Pounds).
Aug. 9 to Aug. 16, . . .	Feeding Period I.	3	6	–	1:3.3	27–31.2	.59
Aug. 16 to Aug. 23, . . .		4	8	–		36.5	.76
Aug. 23 to Aug. 30, . . .		5	10	–		43.9	1.05
Aug. 30 to Sept. 6, . . .		6	12	–		49.5	.80
Sept. 6 to Sept. 13, . . .		6	12	–		56.1	.94
Sept. 13 to Sept. 20, . . .		5	12	4		63.0	.99
Sept. 20 to Sept. 27, . . .		5	14	8		71.6	1.23
Sept. 27 to Oct. 4, . . .		5	16	12		80.3	1.24
Oct. 4 to Oct. 11, . . .	Feeding Period II.	5	28	8	1:4.5	89.0	1.24
Oct. 11 to Oct. 18, . . .		5	32	12		101.7	1.81
Oct. 18 to Oct. 25, . . .		5	36	1[illegible]		112.7	1.56
Oct. 25 to Nov. 1, . . .		5	36	24		126.0	1.90
Nov. 1 to Nov. 8, . . .	Feeding Period III.	4	48	28	1:4.9	143.0	2.40
Nov. 8 to Nov. 15, . . .		4	54	36		151.7	2.40
Nov. 15 to Nov. 22, . . .		4	54	40		175.2	2.20
Nov. 22 to Nov. 28, . . .		4	48	30		182.8	1.08

We now wish to call attention to a summary of the results obtained: —

Summary of Results.

	Average Results of Six Pigs (Pounds).
Live weight,	182.8
Dressed weight,	144.6
Per cent of loss in dressing,	21.6
Live weight gained during experiment,	155.6
Dressed weight gained during experiment,	122.0
Dry matter required to produce 1 pound live weight,	2.27
Dry matter required to produce 1 pound dressed weight,	2.91

Financial Statement.

732.15 pounds dressed pork actually produced during the experiment, at $7\frac{1}{4}$ cents per pound,	$53 07
Cost of food required,	33 94
Profit from pork actually produced,	$19 13
Value of manure produced,	9 61
Total profit from six pigs,	$28 74
Total profit per pig,	4 79

If we take into consideration the first cost of the pigs and the dressed weight actually sold, we have the following: —

$867\frac{3}{4}$ pounds dressed weight actually sold at $7\frac{1}{4}$ cents,		$62 91
Total cost of food consumed,	$35 19	
Cost of pigs, at $3,	18 00	
		53 19
Total profit from pork,		$9 72
Value of manure produced,		10 00
Total profit from six pigs,		$19 72
Total profit per pig,		3 29
Cost of food to produce 1 pound live weight,		3.64 cts.
Cost of food to produce 1 pound dressed weight,		4.64 "
Net cost of food to produce 1 pound dressed weight (obtained by deducting value of manure produced),		3.30 "

The cost of the labor required to care for the pigs during their growth, as well as the cost of preparing them for the market, has not been deducted.

Market Cost of Foods consumed.

Corn meal,	$24 00 per ton.
Buffalo gluten feed,	23 00 per ton.
Skim-milk,	1.8 cents per gallon.

Percentage of the Essential Fertilizer Constituents in the Above Articles of Fodder, and the Commercial Value of the Constituents in 2,000 Pounds of the Foods.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

	Corn Meal.	Gluten Feed.	Skim-milk.
	Per Cent.	Per Cent.	Per Cent.
Moisture,	11.38	6.82	90.50
Nitrogen,	1.80	3.81	0.52
Phosphoric acid,	0.70	0.30	0.19
Potassium oxide,	0.40	0.04	0.20
Valuation per 2,000 pounds,	$6 53	$11 81	$1 95
*Obtainable manurial value per ton,	4 57	8 28	1 36

* Allowing that thirty per cent of the nitrogen, potash and phosphoric acid is retained in the system of the growing animal.

NINETEENTH FEEDING EXPERIMENT WITH PIGS.

December, 1892, to April, 1893.

Six pigs were used in this experiment. They were divided into two lots of three each, and both lots were fed for the first ten days upon skim-milk and corn meal till they became accustomed to their new quarters. Pigs 1 and 4 were barrows, and Nos. 2, 3, 5 and 6 were sows. The pigs came from a Chester White sow, but as they grew Nos. 2, 3 and 6 showed plainly the Yorkshire characteristics. The general mode of treatment was quite similar to that described in the preceding experiment.

Object of the Experiment.

The object of the experiment was: First, a continuation of the many preceding experiments, in order to firmly establish facts relative to the most economical method of feeding skim-milk in combination with various grains and new concentrated fodder articles; in this case the experiment with Buffalo gluten feed was continued. Second, a step was taken in the direction of comparing the relative value of wide *vs.* narrow rations for economical pork production. In the many experiments heretofore made at this station, the general mode of feeding has been what might be termed narrow, *i. e.*, large quantities of nitrogenous matter in proportion to the non-nitrogenous and starchy matter have been fed. The feeding has generally begun with a ration of one part nitrogenous to three parts non-nitrogenous (1 : 3), and has been twice increased during the later feeding periods, till in the last of the three periods (in which the animal has increased in weight from 125 to 180 pounds) the ratio has been one part nitrogenous to four and one-half parts non-nitrogenous (1 : 4.5). Only in one or two cases have wider rations been fed. This method of feeding has been productive of most excellent results. The skim-milk has been most economically utilized, the animals have possessed uniformly good health and the pork has been produced at a comparatively low cost.

In case of three pigs in the present experiment wider rations were fed, beginning with 1 : 4.25 and ending with 1 : 6.5.

From the results obtained in this one experiment no very accurate conclusions can be drawn. What the experiment indicates can be seen from the figures presented further on, and it will be alluded to under our heading of "What our experiments teach us."

Experiments of this kind will be repeated, we hope, *in order to illustrate to our farmers* whether it is more economical to feed young growing pigs (from 25 to 180 pounds) in the beginning rations containing one part of nitrogenous to three parts non-nitrogenous matter (1 : 3), and ending with one part nitrogenous to four and one-half parts non-nitrogenous (1 : 4.5), or whether they can be fed as well or better with rations beginning with one part nitrogenous to four and one-half parts non-nitrogenous (1 : 4.5), and ending with one part nitrogenous to six and one-half parts non-nitrogenous (1 : 6.5).

How the Six Pigs were treated in the Present Experiment.

The pigs were divided into two lots of three each. Lot I., consisting of pigs 1, 2 and 3, was treated in practically the same way as in our previously described experiment. We had during a portion of the time a good supply of skim-milk, and each pig in this lot received at one time as high as ten quarts per day, in addition to his grain feed. The grain consisted of corn meal, and four ounces of Buffalo gluten feed as a substitute for one quart of milk, when the supply of the latter was limited. In case of Lot II. the number of feeding periods was the same, namely, three. During the first period the pigs were fed six ounces of corn meal to each quart of milk, and this continued until the pigs had reached a weight of 80 pounds, and were consuming four and one-half quarts of milk and twenty-seven ounces of corn meal per day. In periods II. and III. the supply of milk was kept at four quarts daily, plus two quarts of water to give the necessary drink, and as much corn meal was added as the animals would consume.

The following tables will, we believe, present concisely and clearly our method of feeding and the results obtained : —

Lot I.

Feeding Periods.	Composition of Ration.	Duration of Period.	Nutritive Ratio.
Period I., .	2 ounces corn meal to each quart milk, .	27 to 75 pounds live weight.	1:3
Period II., .	4 ounces corn meal to each quart milk, and 4 ounces gluten feed as a substitute for each quart milk.	75 to 120 pounds live weight.	1:3.6
Period III.,	6 ounces corn meal to each quart milk, and 4 ounces gluten feed as a substitute for each quart milk.	120 to 175 pounds live weight.	1:4.5

In Period II. of Lot I. we fed as high as ten quarts of skim-milk per day in addition to grain, while in Period III. the quantity of skim-milk, because of the limited supply, was reduced to four or five quarts per day.

Lot II.

Feeding Periods.	Composition of Ration.	Duration of Period.	Nutritive Ratio.
Period I., .	6 ounces corn meal to each quart milk, .	27 to 80 pounds live weight.	1:4.2
Period II., .	4 quarts skim-milk and 2 quarts water, and corn meal *ad libitum*.	80 to 120 pounds live weight.	1:5.3
Period III.,	4 quarts skim-milk and 2 quarts water, and corn meal *ad libitum*.	125 to 180 pounds live weight.	1:6.5

Summary of Results.

The experiment lasted one hundred and twenty-six days, and was productive of the following average results: —

Average Daily Gain.

	Period I. (Pounds).	Period II. (Pounds).	Period III. (Pounds).	Daily Average of One Hundred and Twenty-six Days (Pounds).
Lot I., ...	84	1.33	1.50	1.22
Lot II., ...	.92	1.30	1.60	1.27

	Lot I. Average of Three Pigs (Pounds).	Lot II. Average of Three Pigs. (Pounds).
Live weight, ...	172.71	180.75
Dressed weight, ...	140.75	148.00
Per cent. of loss in dressing, ...	18.53%	18.10%
Live weight gained during experiment, . .	146.17	152.00
Dressed weight gained during experiment, .	119.16	122.47
Dry matter required to produce 1 pound live weight, ...	2.82	2.57
Dry matter required to produce 1 pound dressed weight, ...	3.45	3.18

No difference in the amount of intestinal fat was observed in either lot.

Financial Statements.

No. I.

	Lot I.	Lot II.
Dressed pork actually produced during experiment (pounds), ...	357.5	367.4
Value at $7\frac{3}{4}$ cents per pound (market price), .	$27 71	$28 47
Cost of food consumed, ...	19 95	18 02
Profit from pork actually produced, ...	$7 76	$10 45
Value of manure produced, ...	6 05	4 41
Total profit from three pigs, ...	$13 81	$14 86
Profit per pig, ...	4 60	4 95

If we take into consideration the first cost of the pigs and the dressed weight actually sold, we have the following record for both lots: —

No. II.

866.25 pounds dressed pork actually sold, at $7\frac{3}{4}$ cents,		$67 13
Total cost of food consumed,	$39 05	
Cost of pigs, at $2.25 each,	13 50	
		52 55
Profit from pork,		$14 58
Value of manure produced,		11 38
Total profit from six pigs,		$25 96
Profit per pig,		4 33

	Lot I. (Cents).	Lot II. (Cents).
Cost of food to produce 1 pound live weight,	4.55	3.95
Cost of food to produce 1 pound dressed weight,	5.58	4.91
Net cost of food to produce 1 pound dressed weight (obtained by deducting value of manure produced from cost of food),	3.88	3.90

Market Cost of Foods consumed.

Corn meal,	$23 00 per ton.
Gluten feed,	21 00 per ton.
Skim-milk,	1.8 cents per gallon.

The *percentages* of the essential fertilizer constituents in the above articles of fodder, their *commercial value* in 2,000 pounds, as well as their approximate *obtainable manurial value* when fed to growing pigs, may be seen from the following: —

[Nitrogen at $17\frac{1}{2}$ cents, phosphoric acid at 5 cents, and potassium oxide at $5\frac{1}{2}$ cents, per pound.]

	Per Cent.	Per Cent.	Per Cent.
Moisture,	14.00	7.55	90.24
Nitrogen,	1.36	3.55	.51
Phosphoric acid,	.707	.296	.18
Potash,	.435	.045	.19
Valuation per 2,000 pounds,	$5 95	$12 70	$2 17
Obtainable manurial value,	4 17	8 89	1 52

What our Experiments teach.

Briefly stated, from a practical stand-point, these two experiments and many others made at the station teach us the following lessons: —

I. Skim-milk, together with corn meal, gluten meal, wheat bran, gluten feed, maize feed, etc., combined as above stated, have proved healthy and profitable foods for the production of pork for our markets.

II. With skim-milk reckoned at 1.8 cents per gallon, gluten feed from $21 to $23 per ton and corn meal at $23 to $24 per ton, we have been enabled in these experiments to produce dressed pork at from 4.6 to 5.3 cents per pound. The net cost of the dressed pork produced (obtained by deducting the value of the manure produced) was from 3.3 to 3.8 cents per pound.

III. Farmers having a quantity of skim-milk at their disposal can utilize it profitably by feeding it to growing pigs, as above described. If this milk can be sold, however, at one cent per quart, or more, it would undoubtedly be more profitable to sell it than to use it in the production of pork.

IV. Experiments made at this station have proved that it is not profitable to feed pigs after they reach a weight of 180 to 190 pounds, excepting perhaps when pork commands an exceptionally high price. Fed beyond this weight, the food consumed increases and the percentage of gain in live weight steadily decreases, so that the daily cost of food consumed is more than the value of the daily increase in weight. This fact has since been confirmed by other stations.

V. In the last experiment, Lot II. gave slightly more favorable results than Lot I. These results are not decisive enough to enable us to make any deductions, especially when the results of previous experiments at this station with narrow rations, and experiments elsewhere with both wide and narrow rations, are considered. Repeated trials are necessary to establish facts.

Practical Rations for Pig Feeding.

When skim-milk is used as a part of the daily diet in feeding pigs for the market, the station feels justified, in view of its feeding experiments, in recommending the following practical rations as being valuable in producing pork at a minimum cost: —

I.

Weight of Pigs (Pounds).	Food.	Nutritive Ratio.
20 to 80, .	2 ounces corn meal to each quart milk,* .	1:3.30
80 to 125, .	4 ounces corn meal to each quart milk, . .	1:4.00
125 to 190, .	6 ounces corn meal to each quart milk, . .	1:4.50

* Creamery buttermilk can be substituted for skim-milk as above with good results if it can be had at a reasonable price, say 1.4 cents per gallon.

When skim-milk is in limited supply, from four to six quarts per pig.

II.

Weight of Pigs (Pounds).	Food.	Nutritive Ratio.
20 to 80, .	Milk at disposal, and one part by weight wheat bran, two parts by weight gluten meal, to satisfy appetite.	1:3.20
80 to 120, .	Milk at disposal and following mixture: one weight part corn meal, one weight part wheat bran, one weight part gluten meal, to satisfy animal.	1:4.00
125 to 190, .	Milk at disposal and following mixture: two weight parts corn meal, one weight part wheat bran, one weight part gluten meal.	1:4.50

III.

Weight of Pigs (Pounds).	Food.	Nutritive Ratio.
20 to 80, .	2 ounces corn meal to each quart of milk and 4 ounces gluten feed as a substitute for each quart milk.	1:3.25 to 4.00
80 to 120, .	6 quarts skim-milk and a mixture of one part by weight gluten feed and one part by weight corn meal.	1:4.00 to 4.40
125 to 190, .	6 quarts skim-milk and a mixture of one part by weight gluten feed ana one and one-half parts by weight corn meal.	1:4.4 to 4.9

Analysis of Fodder Articles used in our Pig-feeding Experiments.

Corn Meal.

Average Analysis.

	Used in 18th Experiment.		Used in 19th Experiment.		Per Cent. of Digestibility of Constituents of Corn Meal.
	Percentage Composition.	Nutritive Ratio.	Percentage Composition.	Nutritive Ratio.	
Moisture at 100° C.,	11.38	–	14.00	–	–
Dry matter,	88.62	–	86.00	–	–
	100.00	–	100.00	–	–
Analysis of Dry Matter.					
Crude ash,	1.63	1 : 10.65	1.50	1 : 10.00	–
" cellulose,	2.13		2.58		40
" fat,	4.63		2.44		76
" protein,	10.71		9.87		86
Non-nitrogenous extract matter,	80.90		83.61		95
	100.00		100.00		–

Buffalo Gluten Feed.

Average Analysis.

	Used in 18th Experiment.		Used in 19th Experiment.		Per Cent. of Digestibility of Constituents of Gluten Feed.
	Percentage Composition.	Nutritive Ratio.	Percentage Composition.	Nutritive Ratio.	
Moisture at 100° C.,	6.82	–	7.55	–	–
Dry matter,	93.18	–	92.45	–	–
	100.00	–	100.00	–	–
Analysis of Dry Matter.					
Crude ash,	0.83	1 : 3.46	0.85	1 : 3.80	–
" cellulose,	4.94		10.06		40
" fat,	13.03		12.48		76
" protein,	28.71		23.86		86
Non-nitrogenous extract matter,	52.49		52.75		95
	100.00		100.00		–

Skim-milk.

Average Analysis.

	Used in 18th Experiment.		Used in 19th Experiment.		Per Cent. of Digestibility of Constituents of Skim-milk.
	Percentage Composition.	Nutritive Ratio.	Percentage Composition.	Nutritive Ratio.	
Moisture at 100° C.,	90.50	–	90.24	–	–
Dry matter,	9.50	–	9.76	–	–
	100.00	–	100.00	–	–
Analysis of Dry Matter.					
Crude ash,	6.82	1 : 2.15	8.09	1 : 1.93	–
" fat,	4.00		2.66		100
" protein,	31.50		32.66		100
Non-nitrogenous extract matter,	57.68		56.59		100
	100.00		100.00		–

EIGHTEENTH EXPERIMENT.

Detailed Record.

Pig No. 1.

FEEDING PERIODS.	Corn Meal consumed (Pounds).	Skim-milk consumed (Quarts).	Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
Aug. 9 to Oct. 4, .	38.25	268.00	9.50	1:3.37	25.50	78.00	0.94
Oct. 4 to Nov. 1, .	58.00	140.00	26.63	1:4.47	78.00	126.00	1.71
Nov. 1 to Nov. 29, .	91.88	113.00	62.31	1:4.81	126.00	182.50	2.02

Total Amount of Feed consumed from Aug. 9 to Nov. 29, 1892.

	Dry Matter (Pounds).	Total Cost	Manurial Value Obtainable.	Net Cost.
188.13 pounds corn meal, . .	161.77	$2 26	$0 42	$1 84
521.00 quarts skim-milk, . .	107.63	2 34	0 77	1 57
98.44 pounds gluten feed, . .	91.67	1 13	0 43	0 70
	361.07	$5 73	$1 62	$4 11

Live weight of animal at the beginning of the experiment, 25.50 lbs.
Live weight of animal at the time of killing, . . . 182.50 "
Live weight gained during the experiment, ... 157.00 "
Dressed weight of animal, ... 143.00 "
Loss in weight by dressing, 21.64 per cent, ... 39.50 "
Dressed weight gained during the experiment, . . . 123.02 "
Pounds of dry matter fed produced 1 pound of live weight, 2.30 "
Pounds of dry matter fed produced 1 pound of dressed weight, ... 2.94 "
Total cost of feed per pound of dressed weight gained, . 4.66 cts.
Net cost of feed per pound of dressed weight gained, after deducting 30 per cent of manurial value, ... 3.35 "

Pig No. 2.

FEEDING PERIODS.	Corn Meal consumed (Pounds).	Skim-milk consumed (Quarts).	Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
Aug. 9 to Oct. 4, .	38.25	268.00	9.50	1 : 3.37	28.50	81.00	0.94
Oct. 4 to Nov. 1, .	58.00	140.00	26.63	1 : 4.47	81.00	127.75	1.67
Nov. 1 to Nov. 29, .	85.25	113.00	55.50	1 : 4.85	127.75	183.75	2.00

Total Amount of Feed consumed from Aug. 9 to Nov. 29, 1892.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.	Net Cost.
181.50 pounds corn meal, . .	156.07	$2 18	$0 41	$1 77
521.00 quarts skim-milk, . .	107.63	2 34	0 77	1 57
91.63 pounds gluten feed, . .	85.38	1 05	0 41	0 64
	349.08	$5 57	$1 59	$3 98

Live weight of animal at the beginning of the experiment,	28.50 lbs.
Live weight of animal at the time of killing, . . .	183.75 "
Live weight gained during the experiment, ...	155.25 "
Dressed weight of animal, ...	145.25 "
Loss in weight by dressing, 24.80 per cent, ...	38.50 "
Dressed weight gained during the experiment, . . .	116.75 "
Pounds of dry matter fed produced 1 pound of live weight,	2.25 "
Pounds of dry matter fed produced 1 pound of dressed weight, ...	2.98 "
Total cost of feed per pound of dressed weight gained, .	4.77 cts.
Net cost of feed per pound of dressed weight gained, after deducting 30 per cent of manurial value, ...	3.41 "

Pig No. 3.

FEEDING PERIODS.	Corn Meal consumed (Pounds).	Skim-milk consumed (Quarts).	Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
Aug. 9 to Oct. 4, .	38.25	268.00	9.50	1 : 3.37	30.50	84.00	0.96
Oct. 4 to Nov. 1, .	58.00	140.00	26.63	1 : 4.47	84.00	130.00	1.67
Nov. 1 to Nov. 29, .	88.75	113.00	57.69	1 : 4.94	130.00	183.75	1.92

Total Amount of Feed consumed from Aug. 9 to Nov. 29, 1892.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.	Net Cost.
185.00 pounds corn meal, . .	159.08	$2 23	$0 42	$1 81
521.00 quarts skim-milk, . .	107.63	2 34	0 77	1 57
93.82 pounds gluten feed, . .	87.42	1 08	0 41	0 67
	354.13	$5 65	$1 60	$4 05

Live weight of animal at the beginning of the experiment, 30.50 lbs.
Live weight of animal at the time of killing, . . . 183.75 "
Live weight gained during the experiment, ... 153.25 "
Dressed weight of animal, ... 144.50 "
Loss in weight by dressing, 21.36 per cent, ... 39.25 "
Dressed weight gained during the experiment, . . . 119.68 "
Pounds of dry matter fed produced 1 pound of live weight, 2.31 "
Pounds of dry matter fed produced 1 pound of dressed weight, ... 2.96 "
Total cost of feed per pound of dressed weight gained, . 4.72 cts.
Net cost of feed per pound of dressed weight gained, after deducting 30 per cent of manurial value, ... 3.38 "

Pig No. 4.

FEEDING PERIODS.	Corn Meal consumed (Pounds).	Skim-milk consumed (Quarts).	Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
Aug. 9 to Oct. 4, .	38.25	268.00	9.50	1 : 3.37	24.00	82.00	1.04
Oct. 4 to Nov. 1, .	58.00	140.00	26.63	1 : 4.47	82.00	125.00	1.54
Nov. 1 to Nov. 29, .	88.88	113.00	58.00	1 : 4.94	125.00	181.50	2.02

Total Amount of Feed consumed from Aug. 9 to Nov. 29, 1892.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.	Net Cost.
185.13 pounds corn meal, . .	159.19	$2 23	$0 42	$1 81
521.00 quarts skim-milk, . .	107.63	2 34	0 77	1 57
94.13 pounds gluten feed, . .	87.71	1 09	0 41	0 68
	354.53	$5 66	$1 60	$4 06

Live weight of animal at the beginning of the experiment, 24.00 lbs.
Live weight of animal at the time of killing, . . . 181.50 "
Live weight gained during the experiment, ... 157.50 "
Dressed weight of animal, ... 144.00 "
Loss in weight by dressing, 20.66 per cent, ... 37.50 "
Dressed weight gained during the experiment, . . . 124.97 "
Pounds of dry matter fed produced 1 pound of live weight, 2.25 "
Pounds of dry matter fed produced 1 pound of dressed weight, ... 2.84 "
Total cost of feed per pound of dressed weight gained, . 4.53 cts.
Net cost of feed per pound of dressed weight gained, after deducting 30 per cent of manurial value, ... 3.28 "

Pig No. 5.

FEEDING PERIODS.	Corn Meal consumed (Pounds).	Skim-milk consumed (Quarts).	Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
Aug. 9 to Oct. 4, .	38.25	268.00	9.50	1:3.37	24.50	75.75	0.92
Oct. 4 to Nov. 1, .	58.00	140.00	26.63	1:4.47	75.75	124.75	1.75
Nov. 1 to Nov. 29, .	90.00	113.00	59.56	1:4.94	124.75	182.25	2.05

Total Amount of Feed consumed from Aug. 9 to Nov. 29, 1892.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.	Net Cost.
186.25 pounds corn meal, . .	160.16	$2 23	$0 42	$1 81
521.00 quarts skim-milk, . .	107.63	2 34	0 77	1 57
95.69 pounds gluten feed, . .	89.16	1 10	0 41	0 69
	356.95	$5 67	$1 60	$4 07

Live weight of animal at the beginning of the experiment, 24.50 lbs.
Live weight of animal at the time of killing, . . . 182.25 "
Live weight gained during the experiment, ... 157.75 "
Dressed weight of animal, ... 144.00 "
Loss in weight by dressing, 20.98 per cent, ... 38.25 "
Dressed weight gained during the experiment, . . . 124.73 "
Pounds of dry matter fed produced 1 pound of live weight, 2.26 "
Pounds of dry matter fed produced 1 pound of dressed weight, ... 2.88 "
Total cost of feed per pound of dressed weight gained, . 4.55 cts.
Net cost of feed per pound of dressed weight gained, after deducting 30 per cent of manurial value, ... 3.21 "

Pig No. 6.

FEEDING PERIODS.	Corn Meal consumed (Pounds).	Skim-milk consumed (Quarts).	Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
Aug. 9 to Oct. 4, .	38.25	268.00	9.50	1 : 3.37	30.00	81.00	0.91
Oct. 4 to Nov. 1, .	58.00	140.00	26.63	1 : 4.47	81.00	124.00	1.54
Nov. 1 to Nov. 29, .	89.37	113.00	58.75	1 : 4.94	124.00	183.00	2.11

Total Amount of Feed consumed from Aug. 9 to Nov. 29, 1892.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable	Net Cost.
185.62 pounds corn meal, . .	159.61	$2 23	$0 42	$1 81
521.00 quarts skim-milk, . .	107.63	2 34	0 77	1 57
94.88 pounds gluten feed, . .	88.41	1 09	0 41	0 68
	355.65	$5 66	$1 60	$4 06

Live weight of animal at the beginning of the experiment,	30.00 lbs.
Live weight of animal at the time of killing, . . .	183.00 "
Live weight gained during the experiment, ...	153.00 "
Dressed weight of animal, ...	147.00 "
Loss in weight by dressing, 19.67 per cent, ...	36.00 "
Dressed weight gained during the experiment, . . .	1.23 "
Pounds of dry matter fed produced 1 pound of live weight,	2.32 "
Pounds of dry matter fed produced 1 pound of dressed weight, ...	2.88 "
Total cost of feed per pound of dressed weight gained, .	4.60 cts.
Net cost of feed per pound of dressed weight gained, after deducting 30 per cent of manurial value, ...	3.26 "

NINETEENTH EXPERIMENT.

Detailed Record.

Pig No. 1.

Feeding Periods.	Corn Meal consumed (Pounds).	Gluten Feed consumed (Pounds).	Skim-milk consumed (Quarts).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892-93.							
Dec. 13 to Feb. 7,	43.25	6.25	321.00	1 : 3.00	27.50	77.00	0.88
Feb. 7 to Mar. 14,	49.00	33.25	198.00	1 : 3.65	77.00	122.50	1.28
Mar. 14 to Apr. 18,	120.00	27.81	247.00	1 : 4.50	122.50	175.00	1.53

Total Amount of Feed consumed from Dec. 13, 1892, to April 18, 1893.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.	Net Cost.
212.25 pounds corn meal, . .	182.54	$2 44	$0 44	$2 00
67.31 pounds gluten feed, . .	62.23	0 71	0 30	0 41
766.00 quarts skim-milk, . .	162.23	3 45	1 26	2 19
	407.00	$6 60	$2 00	$4 60

Live weight of animal at the beginning of the experiment, 27.50 lbs.
Live weight of animal at the time of killing, . . . 175.00 "
Live weight gained during the experiment, ... 147.50 "
Dressed weight of animal, ... 144.00 "
Loss in weight by dressing, 17.95 per cent., ... 31.50 "
Dressed weight gained during the experiment, . . . 121.45 "
Pounds of dry matter fed produced 1 pound of live weight, 2.78 "
Pounds of dry matter fed produced 1 pound of dressed weight, ... 3.35 "
Total cost of feed per pound of dressed weight gained, . 5.43 cts.
Net cost of feed per pound of dressed weight gained, after deducting 30 per cent. of manurial value, ... 3.79 "

Pig No. 2.

FEEDING PERIODS.	Corn Meal consumed (Pounds).	Gluten Feed consumed (Pounds).	Skim-milk consumed (Quarts).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892-93.							
Dec. 13 to Feb. 7,	43.25	6.25	321.00	1:3.00	25.25	69.50	0.79
Feb. 7 to Mar. 14,	51.50	35.00	206.00	1:3.65	69.50	113.50	1.26
Mar. 14 to Apr. 18,	126.89	30.81	253.00	1:4.50	113.50	176.00	1.78

Total Amount of Feed consumed from Dec. 13, 1892, to April 18, 1893.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.	Net Cost.
221.64 pounds corn meal, . .	190.61	$2 55	$0 46	$2 09
74.56 pounds gluten feed, . .	68.93	0 72	0 33	0 39
780.00 quarts skim-milk, . .	165.20	3 51	1 28	2 23
	424.74	$6 78	$2 07	$4 71

Live weight of animal at the beginning of the experiment,	25.25 lbs.
Live weight of animal at the time of killing, . . .	176.00 "
Live weight gained during the experiment, ...	150.75 "
Dressed weight of animal, ...	140.00 "
Loss in weight by dressing, 20.45 per cent., ...	36.00 "
Dressed weight gained during the experiment, . . .	119.92 "
Pounds of dry matter fed produced 1 pound of live weight,	2.82 "
Pounds of dry matter fed produced 1 pound of dressed weight, ...	3.54 "
Total cost of feed per pound of dressed weight gained, .	5.65 cts.
Net cost of feed per pound of dressed weight gained, after deducting 30 per cent. of manurial value, ...	3.93 "

Pig No. 3.

FEEDING PERIODS.	Corn Meal consumed (Pounds).	Gluten Feed consumed (Pounds).	Skim-milk consumed (Quarts).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892-93.							
Dec. 13 to Feb. 7,	43.25	6.25	318.00	1:3.00	26.75	77.75	0.91
Feb. 7 to Mar. 14,	51.50	35.00	206.00	1:3.60	77.75	125.25	1.36
Mar. 14 to Apr. 18,	111.50	21.75	251.00	1:4.40	125.25	167.00	1.19

Total Amount of Feed consumed from Dec. 13, 1892, to April 18, 1893.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.	Net Cost.
206.25 pounds corn meal, . .	177.36	$2 37	$0 43	$1 94
63.00 pounds gluten feed, . .	58.24	0 66	0 28	0 38
775.00 quarts skim-milk, . .	164.14	3 49	1 27	2 22
	399.74	$6 52	$1 98	$4 54

Live weight of animal at the beginning of the experiment, 26.75 lbs.
Live weight of animal at the time of killing, . . . 167.00 "
Live weight gained during the experiment, ... 140.25 "
Dressed weight of animal, ... 138.25 "
Loss in weight by dressing, 17.22 per cent., ... 28.75 "
Dressed weight gained during the experiment, . . . 116.11 "
Pounds of dry matter fed produced 1 pound of live weight, 2.85 "
Pounds of dry matter fed produced 1 pound of dressed weight, ... 3.45 "
Total cost of feed per pound of dressed weight gained, . 5.61 cts.
Net cost of feed per pound of dressed weight gained, after deducting 30 per cent. of manurial value, ... 3.91 "

Pig No. 4.

FEEDING PERIODS.	Corn Meal consumed (Pounds).	Skim-milk consumed (Quarts).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892-93.						
Dec. 13 to Feb. 7,	75.38	201.00	1:4.20	30.00	81.00	0.91
Feb. 7 to Mar. 14,	98.13	140.00	1:5.30	81.00	127.00	1.30
Mar. 14 to Apr. 18,	172.50	138.00	1:6.50	127.00	188.00	1.74

Total Amount of Feed consumed from Dec. 13, 1892, to April 18, 1893.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.	Net Cost.
346.00 pounds corn meal, . .	297.56	$3 98	$0 72	$3 26
479.00 quarts skim-milk, . .	101.45	2 15	0 78	1 37
	399.01	$6 13	$1 50	$4 63

Live weight of animal at the beginning of the experiment, 30.00 lbs.
Live weight of animal at the time of killing, . . . 188.00 "
Live weight gained during the experiment, ... 158.00 "
Dressed weight of animal, ... 150.50 "
Loss in weight by dressing, 20.00 per cent., ... 37.50 "
Dressed weight gained during the experiment, . . . 120.51 "
Pounds of dry matter fed produced 1 pound of live weight, 2.52 "
Pounds of dry matter fed produced 1 pound of dressed weight, ... 3.31 "
Total cost of feed per pound of dressed weight gained, . 5.09 cts.
Net cost of feed per pound of dressed weight gained, after deducting 30 per cent. of manurial value, ... 3.84 "

Pig No. 5.

FEEDING PERIODS.	Corn Meal consumed (Pounds).	Skim-milk consumed (Quarts).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892-93.						
Dec. 13 to Feb. 7,	75.38	201.00	1:4.20	26.25	81.00	0.98
Feb. 7 to Mar. 14,	97.88	139.00	1:5.30	81.00	126.00	1.30
Mar. 14 to Apr. 18,	162.44	137.00	1:6.45	126.00	173.00	1.34

Total Amount of Feed consumed from Dec. 13, 1892, to April 18, 1893.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.	Net Cost.
335.70 pounds corn meal, . .	288.70	$3 86	$0 69	$3 17
477.00 quarts skim-milk, . .	101.02	2 14	0 78	1 36
	389.72	$6 00	$1 47	$4 53

Live weight of animal at the beginning of the experiment, 26.25 lbs.
Live weight of animal at the time of killing, . . . 173.00 "
Live weight gained during the experiment, ... 146.75 "
Dressed weight of animal, ... 143.50 "
Loss in weight by dressing, 17.05 per cent., ... 29.50 "
Dressed weight gained during the experiment, . . . 121.73 "
Pounds of dry matter fed produced 1 pound of live weight, 2.66 "
Pounds of dry matter fed produced 1 pound of dressed weight, ... 3.20 "
Total cost of feed per pound of dressed weight gained, . 4.93 cts.
Net cost of feed per pound of dressed weight gained, after deducting 30 per cent. of manurial value, ... 3.72 "

Pig No. 6.

FEEDING PERIODS.	Corn Meal consumed (Pounds).	Skim-milk consumed (Quarts).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892-93.						
Dec. 13 to Feb. 7,	75.38	201.00	1:4.20	30.00	76.00	0.82
Feb. 7 to Mar. 14,	93.38	132.00	1:5.30	76.00	121.50	1.30
Mar. 14 to Apr. 18,	157.68	138.00	1:6.40	121.50	181.25	1.71

Total Amount of Feed consumed from Dec. 13, 1892, to April 18, 1893.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.	Net Cost.
326.44 pounds corn meal, . .	280.74	$3 76	$0 67	$3 09
471.00 quarts skim-milk, . .	99.75	2 12	0 77	1 35
	380.49	$5 88	$1 44	$4 44

Live weight of animal at the beginning of the experiment, 30.00 lbs.
Live weight of animal at the time of killing, . . . 181.25 "
Live weight gained during the experiment, ... 151.25 "
Dressed weight of animal, ... 150.00 "
Loss in weight by dressing, 17.24 per cent., ... 31.25 "
Dressed weight gained during the experiment, . . . 125.17 "
Pounds of dry matter fed produced 1 pound of live weight, 2.52 "
Pounds of dry matter fed produced 1 pound of dressed weight, ... 3.04 "
Total cost of feed per pound of dressed weight gained, . 4.70 cts.
Net cost of feed per pound of dressed weight gained, after deducting 30 per cent. of manurial value, ... 3.55 "

V.

FEEDING EXPERIMENTS WITH CALVES.

One of the chief sources of profit to Massachusetts farmers is the dairy industry. The creamery system is now generally in vogue, and there remains upon the farms the skim-milk, the cream having been taken to the factory. How to economically utilize this milk is a very important question, for upon its disposition depends in no small degree the profit or loss from the herd of cows.

Object of the Experiment.

For a number of years experiments have been carried on at the station with growing pigs. The pigs were fed the skim-milk in combination with various grain rations, and one of the objects aimed at was to ascertain the returns per quart for the skim-milk fed. Further on will be found a statement of the results obtained on the basis of the different selling prices of dressed pork.

With the facts in hand, the next object was to see *what price could be obtained per quart for the skim-milk when fed to young calves*, either alone or in combination with various other materials. Following these brief remarks is a description of the experiment.

Description of the Experiment.

A detailed statement of the record of each calf will be found at the end of the experiment. Calves Nos. 1, 2, 3 and 4 were fed for the first seven to ten days equal parts of fresh and skim milk; then they were quickly brought to a skim-milk diet exclusively. The milk was always given lukewarm. After the first few weeks, in addition to the milk various grains were fed *ad libitum*, and with one exception in a dry state. It is well known that the stomachs of young

calves are exceedingly delicate. During the first two months of their lives they are not able to digest any large quantities of grain; but if the grain is placed before them in a dry state, they will not consume enough to injure them. Beginning with one-fourth of a pound per day, the calves consumed as high as one pound daily by the time they were eight weeks old. These calves drank ten to twelve quarts of milk daily in addition to the grain consumed. The object in feeding the grain was to furnish in a measure the carbohydrates necessary to prevent the rapid destruction of the albuminoids in the animal system that would otherwise follow.

Skim-milk has a nutritive ratio of about 1:2. With a ratio of but two carbohydrates to one of protein, it would not be possible to produce any amount of fat; neither is a feed with such a narrow ratio the most economical one. The calves, however, were not able to consume grain enough to widen the ratio sufficiently to enable them to put on the fat desired.

Scours were noticed in case of calves 2 and 3, which prevented the best results, but the trouble was eventually overcome.

Calves Nos. 5, 6 and 7, with the exception of the first ten days, when equal parts of whole and skim milk were fed, had no other food than skim-milk during the entire experiment. Calf 5, however, for a brief period received a small amount of grain, and calf 7 a small quantity of cod liver oil, to see if any benefit could be observed from its use, both from its general effect upon the system and from its fat-producing qualities. A small quantity (tablespoonful) of lime water was added to the skim-milk at each feeding.

At the beginning of the experiment they consumed six quarts of milk daily, while at the end, with skim-milk as an exclusive food, they drank from sixteen to twenty quarts per day.

The time required to teach the calves to drink was about three days. The calves were kept in separate pens, and weighed weekly. They were kept until they were eight to eleven weeks old.

Record of Calves.

Showing Price per Quart obtained for Skim-milk fed.

Calf 1.

Age when received: three days.
Breed: grade Shorthorn, bull
Grain stirred into the milk.

Foods fed: equal parts of whole milk and skim-milk for the first few days, then skim-milk only, with as much corn meal as the animal would consume.

Financial Statement.

	Debit.	Credit.
Original cost of calf,	$1 00	–
55.2 pounds corn meal, at $23 per ton,	0 63	–
10 quarts fresh milk, at 3 cents,	0 30	–
177 pounds live weight, at $4\frac{1}{2}$ cents,	–	$7 96
489 quarts skim-milk returned,	6 03	–
	$7 96	$7 96

	Cents.
Price returned per quart for skim-milk fed,	1.23
Price returned per quart for skim-milk fed, when live weight brings 4 cents per pound,	1.05

Calf 2.

Age when received: three days.
Breed: grade Jersey, heifer.
Grain consumed dry.

Foods fed: equal parts of skim and whole milk for two weeks (for one week only whole milk, on account of scours), later skim-milk with corn meal, and afterwards equal parts of Buffalo gluten feed and old-process linseed meal *ad libitum.*

Calf 2 — Concluded.

Financial Statement.

	Debit.	Credit.
Original cost of calf,	$1 00	–
8.10 pounds corn meal, at $23 per ton,	0 09	–
8.44 pounds gluten feed, at $20 per ton,	0 08	–
8.44 pounds old-process linseed meal, at $26 per ton,	0 11	–
83.50 quarts whole milk, at 3 cents,	2 50	–
177.50 pounds live weight, at $4\frac{1}{2}$ cents,	–	$7 89
555.50 quarts skim-milk returned,	4 11	–
	$7 89	$7 89

	Cents.
Price returned per quart for skim-milk fed,	0.74
Price returned per quart for skim-milk fed, when live weight brings 4 cents per pound,	0.60

Calf 3.

Age when received: two days.

Breed: grade Ayrshire, heifer.

Grain fed dry.

Foods fed: equal parts of whole milk and skim-milk for the first two weeks (for one week whole milk only, on account of scours), and later skim-milk with equal parts of Buffalo gluten feed and old-process linseed meal.

Financial Statement.

	Debit.	Credit.
Original cost of calf,	$1 00	–
16.10 pounds gluten feed, at $20 per ton,	0 16	–
16.10 pounds old-process linseed meal, at $26 per ton,	0 20	–
77.00 quarts whole milk, at 3 cents,	2 31	–
160.25 pounds live weight, at $4\frac{1}{2}$ cents,	–	$7 21
799.00 quarts skim-milk returned,	3 54	–
	$7 21	$7 21

	Cents.
Price returned per quart for skim-milk fed,	0.44
Price returned per quart for skim-milk fed, when live weight brings 4 cents per pound,	0.34

Calf 4.

Age when received: two days.

Breed: grade Durham, heifer.

Grain consumed dry.

Foods fed: equal parts of fresh and skim milk during first nine days, then skim-milk and wheat flour, followed for a few days by skim-milk and equal parts of wheat flour and old-process linseed meal, and finally skim-milk and equal parts of Buffalo gluten feed and wheat middlings.

Financial Statement.

	Debit.	Credit.
Original cost of calf,	$1 00	–
6.56 pounds wheat flour, at 2 cents,	0 13	–
1.90 pounds old-process linseed meal, at $26 per ton,	0 03	–
13.31 pounds gluten feed, at $20 per ton,	0 13	–
12.44 pounds wheat middlings, at $22 per ton,	0 14	–
32.00 quarts fresh milk, at 3 cents,	0 96	–
185.00 pounds live weight, at 4½ cents,	–	$8 32
873.00 quarts skim-milk returned,	5 93	–
	$8 32	$8 32

	Cents.
Price returned per quart for skim-milk fed,	0.68
Price returned per quart for skim-milk fed, when live weight brings 4 cents per pound,	0.57

Calf 5.

Age when received: three days.

Breed: grade unknown, heifer.

Foods fed: equal parts of fresh and skim milk for the first week, and after that (excepting skim-milk and a small amount of equal parts of Buffalo gluten feed and wheat middlings) skim-milk entirely.

CALF 5 — *Concluded.*

Financial Statement.

	Debit.	Credit.
Original cost of calf,	$1 00	–
2.40 pounds wheat middlings, at $22 per ton,	0 03	–
2.40 pounds gluten feed, at $20 per ton,	0 02	–
27.00 quarts fresh milk, at 3 cents,	0 81	–
189.25 pounds live weight, at $4\frac{1}{2}$ cents,	–	$8 51
936.50 quarts skim-milk returned,	6 65	–
	$8 51	$8 51

	Cents.
Price returned per quart for skim-milk fed,	0.71
Price returned per quart for skim-milk fed, when live weight brings 4 cents per pound,	0.61

CALF 6.

Age when received: three days.

Breed: grade Holstein, heifer.

Foods fed: for first nine days equal parts of whole and skim milk and then skim-milk only.

Financial Statement.

	Debit.	Credit.
Original cost of calf,	$1 25	–
40.00 quarts fresh milk, at 3 cents,	1 20	–
166.50 pounds live weight, at 4 cents,	–	$6 66
617.00 quarts skim-milk returned,	4 21	–
	$6 66	$6 66

	Cents.
Price returned per quart for skim-milk fed,	0.68
Price returned per quart for skim-milk fed, when live weight brings $4\frac{1}{2}$ cents per pound,	0.82

Calf 7.

Age when received: three days.

Breed: grade Shorthorn, heifer.

Foods fed: for first nine days equal parts of whole and skim milk, afterwards skim-milk exclusively, excepting twenty-five ounces of cod liver oil in addition to milk during nineteen days.

Financial Statement.

	Debit.	Credit.
Original cost of calf,	$1 00	–
25.00 ounces cod liver oil, at 2.4 cents,	0 60	–
34.00 quarts whole milk, at 3 cents,	1 02	–
157.25 pounds live weight, at 4 cents,	–	$6 28
621.00 quarts skim-milk returned,	3 66	–
	$6 28	$6 28

	Cents.
Price returned per quart for skim-milk fed,	0.59
Price returned per quart for skim-milk fed, when live weight brings $4\frac{1}{2}$ cents per pound,	0.72

Summary of Above Results.

1. Price returned per quart for skim-milk, when live weight sells at $4\frac{1}{2}$ cents per pound: —

	Cents.
Calves 1, 2, 3 and 4 (grain and skim-milk),	0.77
Calves 5, 6 and 7 (skim-milk alone),	0.75
Average of seven calves,	0.76

2. Price returned per quart for skim-milk, when live weight sells at 4 cents per pound: —

	Cents.
Calves 1, 2, 3 and 4 (grain and skim-milk),	0.64
Calves 5, 6 and 7 (skim-milk alone),	0.63
Average of seven calves,	0.63

Additional Interesting Facts (*Average of Seven Calves*).

Average daily gain in live weight,	1.49 pounds.
Dry matter required to produce 1 pound live weight,	1.77 pounds.
Dry matter required to produce 1 pound dressed weight,	2.98 pounds.
Shrinkage in dressing,	44.22 per cent.
Average number of weeks fed,	10

Price obtained for Skim-milk per Quart when fed to Pigs.

Below are the average results obtained from experiments with forty pigs, being six distinct lots, fed during the years 1890–91 and 1892–93. In this number grade Chester Whites predominated, but several Yorkshires, Berkshires, Poland Chinas and Tamworths are also included. During this time the grains fed had the following average cost per ton: —

Corn meal,	$24 50
Wheat bran,	22 30
Buffalo gluten feed,	24 40
Chicago gluten meal,	25 00

The system of pig feeding developed at the station is generally known. Those not familiar with the experiments will find the methods described in this report at the end of the feeding experiments with pigs under the heading "Practical rations for pig feeding."

To obtain the returns per quart for skim-milk, the original cost of the pig plus the cost of the grains fed are deducted from the value obtained for the dressed weight. The difference represents the value of the skim-milk. See also the same method in the calf experiment.

Statement.

[Cents.]

Dressed Pork sold at—	5½ Cents.	6 Cents.	6½ Cents.	7 Cents.	7½ Cents.	8 Cents.
Price returned per quart for skim-milk fed,	0.21	0.30	0.46	0.58	0.70	0.81

Comments on the Results.

The experiments have shown that calves grown upon skim-milk alone or upon skim-milk and grains during the first eight weeks of their lives make good gains in live weight, namely, from 0.9 to 2.13 pounds per day, with an average of 1.49 pounds. These animals, however, put on very little fat, either when fed on skim-milk alone or when fed on skim-milk and grains. They were not able to digest the necessary amount of corn meal, Buffalo gluten feed, or wheat flour or middlings, when fed in connection with the nitrogenous milk, to promote the formation of fat.

The meat of the animals thus described was quite white in appearance, but not as tender as calves that were fed whole milk. The ribs and flanks of animals thus fed were thinner than those consuming whole milk, and the shrinkage in dressing is from 5 to 7 per cent. more.

Butchers offered from 4 to 4½ cents per pound of live weight, whole-milk veal being worth at the time 5½ to 6 cents per pound. It is to be remarked, however, that at retail as much per pound was charged for the skim-milk as for the whole-milk veal. It will be noticed that when skim-milk veal, so called, brought 4 cents per pound of live weight, an average of 0.63 of a cent per quart or 2.52 cents per gallon was obtained for the skim-milk fed; while when live weight brought 4½ cents per pound the return for the skim-milk was 0.76 of a cent per quart, or 3 cents per gallon. When the skim-milk was fed to pigs, and dressed pork brought 5½ cents per pound, there was a return of 0.2 of a cent per quart for the milk; and when dressed pork brought 7 cents per pound, 0.6 of a cent was obtained per quart for the milk, and 0.7 of a cent was obtained when dressed pork brought 7½ cents per pound.

These results are interesting and instructive, and worthy of the careful consideration of dairy farmers. It must be admitted that calves require rather more attention than pigs. The milk must not be sour and must be fed warm, and their condition must be carefully watched lest they be attacked with scours. A small quantity of lime water added to the milk at each feeding seems to act as a preventive.

No beneficial results were noticed when cod liver oil was fed in small quantities to calf 7. Its smell and taste were obnoxious to the calf, and quite often he refused the milk containing it.

The experiment indicates that, in order to secure the greatest profit, it is not wise as a rule to feed calves as above described after they have reached 160 pounds of live weight. The daily gain decreases and the food consumption steadily increases, so that the commercial value of a pound of live weight is about balanced by the cost of the food consumed to produce it.

This experiment is presented as the beginning of a series designed for the purpose of studying the most economical way in which to feed skim-milk to growing calves, especially to calves intended for veal. Whole milk forms a complete food for calves, and by its use they can be sold from five to seven weeks from birth in a fat condition. How to secure a food equal in its effect to whole milk by utilizing the skim-milk and substituting a cheaper fattening material in place of the cream removed, is the problem for future solution.

TABLES SHOWING AVERAGE DAILY FOOD CONSUMPTION AND GAIN IN LIVE WEIGHT.

CALF 1.

WEEKLY PERIODS (DATES).	Weight of Animal (Pounds)	Average Daily Amount of Grain consumed (Ounces).	AVERAGE DAILY AMOUNT OF MILK CONSUMED	
			Fresh Milk (Quarts).	Skim-milk (Quarts).
April 4-7, . . .	–	–	3.33	4.70
14, . . .	99.50	7.14	–	8.86
21, . . .	117.25	10.00	–	10.00
28, . . .	132.25	12.86	–	10.00
May 4, . . .	160.25	16.71	–	11.43
11, . . .	167.75	20.00	–	9.71
18, . . .	180.25	28.57	–	8.00
25, . . .	177.00	21.14	–	7.57
27, . . .	177.00	28.00	–	8.00
Total gain in 54 days,	77.50	18.05	–	8.70
Average daily gain, .	1.43	–	–	–

CALF 2.

WEEKLY PERIODS (DATES).	Weight of Animal (Pounds).	Average Daily Amount of Grain consumed (Ounces).	AVERAGE DAILY AMOUNT OF MILK CONSUMED.	
			Fresh Milk (Quarts).	Skim-milk (Quarts).
April 18, . . .	74.00	–	–	–
24, . . .	77.25	–	1.64	3.21
May 4,* . . .	88.00	–	5.40	0.05
11, . . .	105.75	–	2.57	7.14
18, . . .	117.75	–	–	12.00
25, . . .	125.75	3.57	–	11.14
June 1, . . .	137.50	12.14	–	10.00
8, . . .	152.00	8.72	–	9.57
15, . . .	163.75	9.58	–	10.00
22, . . .	173.25	10.86	–	10.00
26, . . .	175.50	16.50	–	9.50
Total gain in 70 days,	101.50	10.23	–	8.26
Average daily gain, .	1.45	–	–	–

* Ten-day period.

CALF 3.

April 21, ...	53.25	–	–	–
May 4,* . . .	59.00	–	3.53	1.13
11, ...	73.25	–	3.43	5.30
18, ...	84.25	–	–	11.00
25, ...	92.25	–	–	11.43
June 1, ...	99.25	–	–	12.00
8, ...	109.50	7.58	–	10.71
15, ...	118.25	7.14	–	10.00
22, ...	125.25	6.86	–	10.00
29, ...	137.25	10.86	–	9.71
July 6, ...	148.00	12.00	–	10.00
13, ...	155.50	15.72	–	10.00
21, ...	160.25	13.00	–	11.75
Total gain in 92 days,	107.00	10.45	–	8.78
Average daily gain, .	1.16	–	–	–

* Fifteen-day period.

CALF 4.

WEEKLY PERIODS (DATES).	Weight of Animal (Pounds).	Average Daily Amount of Grain consumed (Ounces).	AVERAGE DAILY AMOUNT OF MILK CONSUMED.	
			Fresh Milk (Quarts).	Skim-milk (Quarts).
June 10, ...	70.75	–	–	–
16, ...	78.75	–	3.14	3.14
23, ...	88.25	–	1.43	8.00
30, ...	101.25	–	–	10.57
July 7, ...	118.75	–	–	9.00
14, ...	127.00	7.43	–	9.71
21, ...	142.00	8.14	–	10.00
28, ...	152.00	8.57	–	10.00
Aug. 4, ...	154.50	7.43	–	11.14
11, ...	163.25	8.57	–	12.00
18, ...	175.00	10.00	–	12.00
25, ...	180.75	11.14	–	12.00
Sept. 4, ...	185.00	12.60	–	12.00
Total gain in 87 days,	114.25	9.23	–	9.96
Average daily gain, .	1.31	–	–	–

CALF 5.

July 22, ...	70.00	–	–	–
28, ...	83.50	–	4.74	4.14
Aug. 4, ...	96.00	–	–	10.86
11, ...	108.75	–	–	12.00
18, ...	112.50	–	–	10.71
25, ...	122.75	3.14	–	9.30
Sept. 1, ...	128.25	7.71	–	10.50
8, ...	141.50	–	–	12.86
15, ...	157.25	–	–	17.71
22, ...	178.50	–	–	20.00
Oct. 1, ...	189.25	–	–	20.00
Total gain in 72 days,	119.25	–	–	12.81
Average daily gain, .	1.63	–	–	–

CALF 6.

WEEKLY PERIODS (DATES).	Weight of Animal (Pounds).	Average Daily Amount of Grain consumed (Ounces).	AVERAGE DAILY AMOUNT OF MILK CONSUMED.	
			Fresh Milk (Quarts).	Skim-milk (Quarts).
Sept. 29, ...	68.00	–	–	–
Oct. 5, ...	83.75	–	3.71	3.71
12, ...	95.25	–	2.00	8.00
19, ...	110.50	–	–	11.29
26, ...	126.50	–	–	13.71
Nov. 2, ...	137.00	–	–	13.71
9, ...	152.50	–	–	14.86
19, ...	169.50	–	–	16.00
Total gain in 52 days,	101.50	–	–	11.61
Average daily gain, .	1.95	–	–	–

CALF 7.

Oct. 1, ...	74.25	–	–	–
7, ...	83.75	–	4.00	4.57
14, ...	95.75	–	0.86	9.43
21, ...	108.50	–	–	11.71
28, ...	120.50	–	–	13.14
Nov. 4, ...	126.50	–	–	11.68
11, ...	141.50	–	–	12.29
18, ...	155.50	–	–	14.00
24, ...	157.25	–	–	13.67
Total gain in 55 days,	83.00	–	–	11.31
Average daily gain, .	1.51	–	–	–

Tables giving Detailed Record of Each Calf.

Calf 1.

Feeding Periods.	Date of Periods.	Whole Milk (Quarts).	Skim-milk (Quarts).	Corn Meal (Ounces).	Approximate Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Average Daily Gain (Pounds).	Cost of Feed per Pound of Live Weight Gained (Cents).
I.	April 4 to April 21,	10.00	156.00	120.00	1:2.5 to 1:3.5	99.50	132.25	1.82	3.32
II.	April 22 to May 5,	-	150.00	227.00		132.25	160.25	2.00	3.00
III.	May 6 to May 27,	-	183.00	536.00		160.25	177.00	0.76	7.22

Total Amount of Feed consumed from April 4 to May 27, 1893.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.
10.00 quarts whole milk, ...	2.97	$0 30	$0 02
489.00 quarts skim-milk, ...	100.72	2 20	0 81
55.20 pounds corn meal, ...	43.80	0 63	0 10
	147.49	$3 13	$0 93

Live weight of the animal at the beginning of the experiment,	99.50 lbs.
Live weight of the animal at the end of the experiment, .	177.00 "
Live weight gained during the experiment, ...	77.50 "
Dressed weight of the animal, ...	100.00 "
Loss in weight by dressing, 43.50 per cent., . . .	77.00 "
Pounds of dry matter to produce 1 pound of live weight, .	1.93 "
Pounds of dry matter to produce 1 pound of dressed weight,	3.37 "
Total cost of feed per pound of live weight gained, . .	4.04 cts.
Net cost of feed per pound of live weight gained, . .	3.00 "

CALF 2.

Feeding Periods.	Date of Periods.	Whole Milk (Quarts).	Skim-milk (Quarts).	Corn Meal (Ounces).	Gluten Feed (Ounces).	Old-process Linseed Meal (Ounces).	Approximate Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Average Daily Gain (Pounds).	Cost of Feed per Pound of Live Weight Gained (Cents).
I.	Apr. 18 to May 12,	83.50	90.50	-	-	-	1:2.00 to 1:3.00	74.00	105.75	1.27	9.17
II.	May 13 to June 2,	-	230.00	130.00	-	-		105.75	137.50	1.51	3.55
III.	June 3 to June 16,	-	137.00	-	69.00	69.00		137.50	163.75	1.87	2.73
IV.	June 17 to June 26,	-	98.00	-	66.00	66.00		163.75	175.50	1.17	4.56

Total Amount of Feed consumed from April 18 to June 26, 1893.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.
83.50 quarts whole milk, ...	24.81	$2 51	$0 15
555.50 quarts skim-milk, ...	116.01	2 50	0 93
8.10 pounds corn meal, . . .	6.94	0 09	0 02
8.44 pounds Buffalo gluten feed, . .	7.65	0 08	0 04
8.44 pounds old-process linseed meal, .	7.49	0 11	0 06
	162.90	$5 29	$1 20

Live weight of the animal at the beginning of the experiment,	74.00 lbs.
Live weight of the animal at the end of the experiment, .	175.50 "
Live weight gained during the experiment, ...	101.50 "
Dressed weight of the animal, ...	92.00 "
Loss in weight by dressing, 48 per cent., ...	83.50 "
Pounds of dry matter to produce 1 pound of live weight, .	1.60 "
Pounds of dry matter to produce 1 pound of dressed weight,	3.04 "
Total cost of feed per pound of live weight gained, . .	5.21 cts.
Net cost of feed per pound of live weight gained, . .	4.02 "

CALF 3.

Feeding Periods.	Date of Periods.	Whole Milk (Quarts).	Skim-milk (Quarts).	Corn Meal (Ounces).	Gluten Feed (Ounces).	Old-process Linseed Meal (Ounces).	Approximate Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Average Daily Gain (Pounds).	Cost of Feed per Pound of Live Weight Gained (Cents).
I.	Apr. 21 to June 2,	77.00	294.00	10.00	–	–	1:2.00 to 1:2.50	53.25	99.25	1.10	7.89
II.	June 3 to June 30,	–	281.00	–	113.50	113.50		99.25	137.25	1.36	3.76
III.	July 1 to July 21,	–	224.00	–	144.00	144.00		137.25	160.25	1.10	5.28

Total Amount of Feed consumed from April 21 to July 21, 1893.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.
77.00 quarts whole milk, . . .	22.88	$2 31	$0 14
799.00 quarts skim-milk, ...	166.87	3 59	1 34
0.62 pounds corn meal, . . .	0.53	0 01	–
16.10 pounds Buffalo gluten feed, . .	14.59	0 16	0 08
16.10 pounds old-process linseed meal, .	14.30	0 21	0 12
	219.17	$6 28	$1 67

Live weight of the animal at the beginning of the experiment,	53.25 lbs.
Live weight of the animal at the end of the experiment, .	160.25 "
Live weight gained during the experiment, ...	107.00 "
Dressed weight of the animal, ...	–
Loss in weight by dressing, ...	–
Pounds of dry matter to produce 1 pound of live weight, .	2.03 "
Pounds of dry matter to produce 1 pound of dressed weight,	–
Total cost of feed per pound of live weight gained, . .	5.87 cts.
Net cost of feed per pound of live weight gained, . .	4.30 "

CALF 4.

Feeding Periods.	DATE OF PERIODS.	Whole Milk (Quarts).	Skim-milk (Quarts).	Wheat Flour (Ounces)	Old-process Linseed Meal (Ounces).	Gluten Feed (Ounces).	Wheat Middlings (Ounces).	Approximate Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Average Daily Gain (Pounds).	Cost of Feed per Pound of Live Weight Gained (Cents).
I.	June 10 to June 30,	32.00	152.00	–	–	–	–	1:2.00 to 1:2.5	70.75	101.75	1.48	5.30
II.	July 1 to July 14,	–	131.00	44.00	–	–	–		101.75	127.00	1.80	2.51
III.	July 15 to Aug. 11,	–	302.00	61.00	30.00	76.00	62.00		127.00	163.25	2.13	4.37
IV.	Aug. 12 to Sept. 4,	–	288.00	–	–	137.00	137.00		163.25	185.00	0.90	7.14

Total Amount of Feed consumed from June 10 to Sept. 4, 1893.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.
32.00 quarts whole milk,	9.49	$0 96	$0 08
873.00 quarts skim-milk,	180.18	3 85	1 43
6.56 pounds wheat flour,	5.73	0 13	0 02
1.90 pounds old-process linseed meal,	1.69	0 02	0 01
13.31 pounds Buffalo gluten feed,	12.06	0 13	0 06
12.44 pounds wheat middlings,	11.06	0 13	0 05
	220.21	$5 22	$1 65

Live weight of the animal at the beginning of the experiment,	70.75 lbs.
Live weight of the animal at the end of the experiment,	185.00 "
Live weight gained during the experiment,	114.25 "
Dressed weight of the animal,	101.00 "
Loss in weight by dressing, 45 per cent.,	84.00 "
Pounds of dry matter to produce 1 pound of live weight,	1.93 "
Pounds of dry matter to produce 1 pound of dressed weight,	3.51 "
Total cost of feed per pound of live weight gained,	4.57 cts.
Net cost of feed per pound of live weight gained,	3.12 "

CALF 5.

Feeding Periods.	Date of Periods.	Whole Milk (Quarts).	Skim-milk (Quarts).	Gluten Feed (Ounces).	Wheat Middlings (Ounces).	Approximate Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Average Daily Gain (Pounds).	Cost of Feed per Pound of Live Weight Gained (Cents).
I.	July 22 to Aug. 4.	27.00	105.00	–	–		70.00	96.00	1.86	4.83
II.	Aug. 5 to Sept. 1,	–	297.50	38.00	38.00	1:2.00	96.00	128.25	1.12	4.34
III.	Sept. 2 to Sept. 15,	–	214.00	–	–		128.25	157.25	2.09	3.32
IV.	Sept.16 to Oct. 1,	–	320.00	–	–		157.25	189.25	2.00	4.50

Total Amount of Feed consumed from July 22 to Oct. 1, 1893.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.
27.00 quarts whole milk, ...	8.02	$0 81	$0 05
936.50 quarts skim-milk, ...	195.58	4 21	1 57
2.40 pounds Buffalo gluten feed, . .	2.18	0 02	0 01
2.40 pounds wheat middlings, . .	2.13	0 03	0 01
	207.91	$5 07	$1 64

Live weight of the animal at the beginning of the experiment,	70.00 lbs.
Live weight of the animal at the end of the experiment, .	189.25 "
Live weight gained during the experiment, ...	119.25 "
Dressed weight of the animal, ...	108.00 "
Loss in weight by dressing, 43 per cent., ...	81.25 "
Pounds of dry matter to produce 1 pound of live weight, .	1.74 "
Pounds of dry matter to produce 1 pound of dressed weight,	2.67 "
Total cost of feed per pound of live weight gained, . .	4.25 cts.
Net cost of feed per pound of live weight gained, . .	3.72 "

CALF 6.

Feeding Periods.	Date of Periods.	Whole Milk (Quarts).	Skim-milk (Quarts).	Approximate Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Average Daily Gain (Pounds).	Cost of Feed per Pound of Live Weight Gained (Cents).
I.	Sept. 29 to Oct. 13, .	40.00	92.00	1:2.00 to 1:2.25	68.00	95.25	1.82	5.92
II.	Oct. 14 to Oct. 27, .	-	179.00		95.25	125.50	1.68	2.66
III.	Oct. 28 to Nov. 19, .	-	346.00		125.50	166.50	1.78	3.79

Total Amount of Feed consumed from Sept. 29 to Nov. 19, 1893.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.
40.00 quarts whole milk, . . .	11.89	$1 20	$0 07
617.00 quarts skim-milk, ...	128.86	2 77	1 04
	140.74	$3 97	$1 11

Live weight of the animal at the beginning of the experiment,	68.00 lbs
Live weight of the animal at the end of the experiment, .	166.50 "
Live weight gained during the experiment, ...	98.50 "
Dressed weight of the animal, ...	90.00 "
Loss in weight by dressing, 45 per cent., ...	46.50 "
Pounds of dry matter to produce 1 pound of live weight, .	1.43 "
Pounds of dry matter to produce 1 pound of dressed weight,	2.37 "
Total cost of feed per pound of live weight gained, . .	4.03 cts.
Net cost of feed per pound of live weight gained, . .	2.90 "

CALF 7.

Feeding Periods.	DATE OF PERIODS.	Whole Milk (Quarts).	Skim-milk (Quarts).	Cod Liver Oil (Ounces).	Approximate Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Average Daily Gain. (Pounds).	Cost of Feed per Pound of Live Weight Gained (Cents).
I.	Oct. 1 to Oct. 13, .	34.00	86.00	-	1 : 2.00	74.25	95.75	1.65	6.62
II.	Oct. 14 to Oct. 27, .	-	174.00	25.00		95.75	120.50	1.77	5.59
III.	Oct. 28 to Nov. 24, .	-	361.00	-		120.50	157.25	1.31	4.39

Total Amount of Feed consumed from Oct. 1 to Nov. 24, 1893.

	Dry Matter (Pounds).	Total Cost.	Manurial Value Obtainable.
34.00 quarts whole milk, . . .	10.24	$1 02	$0 06
621.00 quarts skim-milk, . . .	129.69	2 79	1 04
25.00 ounces cod liver oil, . . .	1.56	0 60	–
	141.49	$4 41	$1 10

Live weight of the animal at the beginning of the experiment,	74.25 lbs.
Live weight of the animal at the end of the experiment, .	157.25 "
Live weight gained during the experiment, ...	83.00 "
Dressed weight of the animal, ...	91.00 "
Loss in weight by dressing, 42 per cent., ...	66.25 "
Pounds of dry matter to produce 1 pound of live weight, .	1.70 "
Pounds of dry matter to produce 1 pound of dressed weight,	2.94 "
Total cost of feed per pound of live weight gained, . .	5.31 cts.
Net cost of feed per pound of live weight gained, . .	3.99 "

Local Market Cost per Ton of the Various Articles of Fodder used.

Corn meal, ...	$23 00
Buffalo gluten feed, ...	20 00
Old-process linseed meal, ...	26 00
Wheat middlings, ...	22 00
Skim-milk, per gallon, ...	1.8 cts.
Whole milk, per quart, ...	3.0 cts.
Wheat flour, per pound, ...	2.0 cts.
Cod liver oil, per gallon, ...	$3 00

Analyses of Fodder Articles used.

FODDER ANALYSES.	Corn Meal.	Buffalo Gluten Feed.	Old-process Linseed Meal.	Wheat Middlings.	Skim-milk.	Whole Milk.
Moisture at 100° C.,	14.24*	9.38	11.21	11.12	90.42	86.18
Dry matter,	85.76	90.62	88.79	88.88	9.58	13.82
	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.						
Crude ash,	1.63	0.98	6.97	3.48	8.14	5.35
" cellulose,	1.93	8.06	8.21	3.97	-	-
" fat,	3.27	14.47	8.27	5.92	2.61	33.43
" protein,	10.26	25.79	36.75	20.07	35.23	25.33
Non-nitrogenous extract matter,	82.91	50.70	39.80	66.56	54.02	35.89
	100.00	100.00	100.00	100.00	100.00	100.00

* Moisture, as fed to calf 1, 20.67.

Fertilizing Constituents.

[Nitrogen 17½ cents, phosphoric acid 5 cents, potassium oxide 5½ cents, per pound.]

FERTILIZER ANALYSES.	Wheat Flour.	Corn Meal.	Buffalo Gluten Feed.	Old-process Linseed Meal.	Wheat Middlings.	Skim-milk.	Whole Milk.
Moisture,	12.60	14.24	9.38	11.21	11.12	90.42	86.18
Nitrogen,	1.90	1.41	3.73	5.22	2.84	0.52	0.56
Phosphoric acid,	0.24	0.70	0.46	1.78	1.54	0.18	0.19
Potassium oxide,	0.18	0.40	0.10	1.21	0.87	0.19	0.17
Value per 2,000 pounds,	$7 09	$6 08	$13 63	$21 38	$12 44	$2 21	$2 34
Manurial value obtainable,*	4 96	4 26	9 54	14 97	8 71	1 55	1 64

* Allowing thirty per cent. of the fertilizing constituents to be retained in the system of the growing animal.

VI.

DIGESTION EXPERIMENTS WITH SHEEP.

BY J. B. LINDSEY.*

Experiments to determine the digestibility of various foods have been conducted quite extensively in Germany for the last twenty-five years, and during the past ten years many experiments of a similar nature have been carried out by various experiment stations in the United States.

VALUE OF DIGESTION EXPERIMENTS.

1. A food is valuable as a source of nourishment only in so far as its various constituents can be digested and assimilated. Two kinds of hay, one early and the other late cut, might be consumed in equal quantities by an animal, yet the early cut hay, having from ten to fifteen per cent. more digestible matter, would prove the more valuable fodder.

For one to form an intelligent opinion as to the value of different fodder stuffs, the amount of digestible matter they contain must be known.

2. It has been demonstrated that, in order to keep a milch cow of one thousand pounds live weight in good condition and to enable her to give the largest quantity of milk, she needs approximately 2.5 to 3 pounds of digestible protein, .5 pound of digestible fat and 12.5 pounds of digestible carbohydrates daily.

In combining the various foods so as to furnish approximately such a ration, it is absolutely essential that one should know the various percentages of the different digestible constituents they contain.

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* It is desired to acknowledge the efficient and painstaking services rendered by Messrs. E B. Holland, C. H. Johnson, C. H. Jones and H. D. Haskins. Mr. Johnson assisted in the stable and laboratory, Messrs. Jones and Haskins in the laboratory, and Mr. Holland in the laboratory and in collating the data.

What the Excreta of an Animal is.

The fæces are nothing more than the undigested portion of the food. It is the portion that has resisted the action of the various secretions of the stomach and digestive fluids and bacteria of the intestines, and is consequently excreted by the animal as so much worthless material. The urine is entirely distinct from the fæces. It contains the water, and the end products of the digestion of the nitrogenous portion of the food, — the urea and hippuric acid, — which have been removed from the blood by the kidneys. It also contains about one-third of the phosphoric acid and nearly all of the alkalies of the food consumed that have not been retained in the animal's system, and small quantities of other materials that it is unnecessary to consider in this connection.

How the Digestible Matter of a Food is Determined.

First ascertain the amount and composition of the food consumed by an animal in a given length of time, also the amount and composition of the fæces or undigested portion excreted in the same time on the basis of dry matter. The difference between them will represent the amount of the various constituents of the food digested.

The percentages of the constituents digested are called the digestion coefficients.

DESCRIPTION OF THE PRESENT EXPERIMENT.

It has been found that ruminants — cows, steers, sheep, etc. — digest very nearly equal quantities of the same foods.* Sheep being easier to work with, the experiments here reported were conducted with these animals. The animals were grade Southdown wethers. Nos. I. and II. were three-year-olds, and Nos. III. and IV. yearlings. They weighed about one hundred pounds each.

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* See exception to this in Pennsylvania Station Report, page 46, 1890. This experiment showed that sheep digested fourteen to fifteen per cent. less dry matter, cellulose and nitrogen-free extract matter, and only one-half as much protein, as did steers, in case of ensilage made from Burrell and Whitman corn.

The animals were fed a certain weighed quantity of food for fourteen days. The first seven days were regarded as a preliminary period. This preliminary time allowed the animals to become accustomed to the new feed, and to eliminate all the previous foods from the intestines. The animals were fed a so-called maintenance ration, which is a quantity of food sufficient to keep them in good health and condition, without either gaining or losing in weight. During the last seven days the fæces were carefully collected and accurately weighed, and an aliquot part — one-tenth — dried daily and preserved for analysis.

The temperature of the barn, amount of water drank and the amount and specific gravity of the urine were also carefully noted.

The food fed was weighed out in advance for the entire period, carefully sampled, moisture determinations made at once, and a sample reserved for complete analysis. The animals were weighed at the beginning and end of each quantitative period.

Method employed in Collecting the Fæces and Urine.

The cut presented in connection with this experiment gives a clear idea of the arrangement. The animals were confined in wooden stalls, forty-two inches long by twenty-four inches wide, raised fourteen inches above the barn floor.

By means of a light leather harness a rubber bag is securely attached behind, to collect the fæces, and a rubber funnel conducts the urine down into a bottle placed beneath the stall. The animal stands upon cushions of about one and one-half inches in thickness.

Water is before the animal at all times, contained in a galvanized-iron pan, placed on a bracket, as in figure I.

The food is given in a large zinc pan, which is made to fit tightly into the stall and can be removed at will (see just below figure 4).

The fæces were collected twice daily in large glass-stoppered bottles, and every morning one-tenth of the twenty-four hours' collection was dried and preserved.

Sheep Harnessed for Digestion Experiments at the Massachusetts State Experiment Station, 1893.

Analytical Methods.

At the close of the period these daily "tenths," after being weighed in an approximately air-dry condition, were mixed, and after being once run through a coarse grinding mill to break the pellets, duplicate dry matter determinations were made and the material then ground fine for a complete analysis.

Moisture determinations were made in an air bath at a temperature of 102° to 103° C., about seven grams of substance being taken. Total nitrogen was determined by the Kjeldahl method. The fat was extracted with anhydrous ether. The methods for the determination of ash and cellulose were those described by the Association of Official Agricultural Chemists.

The Feeds tested.

The object in making these experiments has been to obtain a knowledge of the comparative digestibility of the various concentrated by-products, so called, that are being so extensively offered for sale in our Massachusetts markets. The digestibility of hay of mixed grasses grown upon the station grounds was first determined, and then a certain amount of the concentrated food was substituted for an equal amount of the hay, as the data that is to follow will show.

Brief Description of the Feeds tested.

Hay of Mixed Grasses.

The hay is intended to be a fair average of that grown upon the station grounds. It was harvested the latter part of June, when the various grasses were in blossom. The grasses composing the same were principally herd's grass, red top, Kentucky blue-grass, meadow fescue, sweet-scented vernal grass and a fair sprinkling of clover.

Buffalo Gluten Feed.

This is a by-product in the manufacture of starch from corn. The starch is separated from the yellow or albuminous

part of the grain by means of water. The hulls and germs are separated by screening. After the starch is removed the yellow or flinty portion is mixed with the germs and hulls. The mixture is kiln dried and partially ground.

New and Old Process Linseed Meals.

Linseed meal is that part of the seed of the flax remaining after the oil has been removed. In case of the new-process meal the fat is more thoroughly removed. Both products were in good mechanical condition, and after a few days the animals consumed them eagerly.

Dried Brewers' Grains.

This is that part of the barley remaining after the starch has been largely removed by sprouting and fermentation. In order that the grains can be transported they are eventually kiln dried. The sample was in excellent condition.

Corn Cobs.

These cobs were ground as fine as was practicable by our local miller. When fed they were mixed with about one-half their weight of linseed meal.

Spring and Winter Wheat Brans.

These brans were in good condition, and, so far as chemical analysis indicates, had approximately the same composition.

Wheat Middlings.

This was a very good quality of middlings, being ground as fine as flour. It was quite light in color.

The table of analysis of the above feeds will be found a few pages farther on.

A SINGLE ILLUSTRATION

Showing how the digestibility of a fodder is determined. Solid manure equals the undigested part of food.

English Hay.

	Dry Matter (Grams).	Crude Cellulose (Grams).	Crude Fat (Grams).	Crude Protein (Grams).	Extract Matter (Grams).
900 grams hay fed, equal to . . .	765.36	250.58	23.57	82.58	348.69
369.3 grams manure excreted, equal to	337.95	107.00	12.81	34.64	145.89
Amount of hay digested, . .	427.41	143.58	10.76	47.94	202.80
Per cent. digested, ...	55.84	57.30	45.65	58.05	58.16

A detailed account of the various digestion experiments made at this station during the past year will be found in the pages following. In the table below is presented a *résumé* of the results obtained: —

Results of the Experiment.

Digestibility of the Foods.

KIND OF FOOD.	Number of Different Samples.	Number of Experiments	Number of Animals.	Dry Matter (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Hay of mixed grasses (*a*),	1	1	3	61	64	51	63	63
Hay of mixed grasses (*b*),	1	1	4	56	57	47	57	58
Average both samples,	2	2	7	58	60	49	60	60
Buffalo gluten feed,	1	1	2	78	43	81	85	81
New-process linseed meal,	1	1	2	81	61	91	87	86
Old-process linseed meal,	1	1	3	79	57	89	89	78
Corn cobs,	1	1	2	59	65	59	17	60
Dried brewers' grains,	1	1	2	62	53	91	79	59
Spring wheat bran,	1	1	2	63	24	76	80	70
Winter wheat bran,	1	1	1	66	56	61	79	70
Wheat middlings,*	1	1	2	83	36	85	85	88

* Very fine and quite light colored.

Brief Remarks on the Above Results.

The Buffalo gluten feed proves to be quite digestible. The fat has approximately the same degree of digestibility as in corn meal, while the protein appears even more digestible. The cellulose and extract matter, however, fall somewhat below those of the corn meal, as would be expected.

The new and old process linseed meals compare very favorably with each other, only slight differences being observed.

Corn cobs appear fully as digestible as a good quality of English hay, with the exception of the protein, of which they contain but a small amount.

Dried brewers' grains and wheat bran approach each other very closely in the amount of dry matter digested. The digestibility of the protein in both cases appears practically identical. The fat in the brewers' grains appears rather more digestible than that in the bran, while in case of the extract matter the opposite is the result.

Winter wheat bran generally costs about two dollars per ton more in the retail markets than does the spring bran, and it was our object to see if analysis and digestibility warranted this extra price. So far as composition is concerned, the two brans are practically alike. We regret that at present positive conclusions cannot be drawn from the digestion experiments. In case of the winter wheat bran, through an unfortunate circumstance only the results obtained with one sheep can be presented. From the results offered it will be noticed that the protein and extract matter have almost identical coefficients, but the fat appears rather more digestible in the spring bran, and the cellulose more digestible in the winter bran. As these two latter ingredients are of minor importance, however, because of their comparative small absolute percentage when compared with the protein and extract matter, the comparative value of the two brans would not be seriously affected. Therefore the results thus far would indicate no material difference between the two brans. The experiment will be repeated, however, at an early date, and as soon as more decisive results are obtained they will be published.

The finer grade of wheat middlings coincides very closely in digestibility with Buffalo gluten feed. The chief difference between the two feeds is that the Buffalo gluten feed contains about four per cent. more protein than the wheat middlings.

Details of the Experiment.

Dry Matter Determinations made at the Time of weighing out the Different Foods, and Dry Matter in Manure Excreted.

Sheep I.

Periods.	Hay.	Buffalo Gluten Feed.	New-process Linseed Meal.	Old-process Linseed Meal.	Corn Cobs.	Dried Brewers' Grains.	Spring Wheat Bran.	Wheat Middlings.	Waste.	Manure.
III., . . .	85.04	–	–	–	–	–	–	–	–	91.51
VI., . . .	85.34	–	88.10	–	87.95	–	–	–	–	92.47
VII., . .	86.60	–	–	–	–	89.68	–	–	–	95.34
X., . . .	87.24	–	–	–	–	–	–	86.94	–	94.39

Sheep II.

Periods.	Hay.	Buffalo Gluten Feed.	New-process Linseed Meal.	Old-process Linseed Meal.	Corn Cobs.	Dried Brewers' Grains.	Spring Wheat Bran.	Wheat Middlings.	Waste.	Manure.
I., . . .	84.24	–	–	–	–	–	–	–	79.33	92.07
II., . . .	83.51	90.59	–	–	–	–	–	–	77.67	88.78
III., . . .	85.04	–	–	–	–	–	–	–	–	91.56
IV., . . .	87.73	–	88.28	–	–	–	–	–	–	94.53
V., . . .	86.23	–	–	87.28	–	–	–	–	–	94.79
VI., . . .	85.34	–	88.10	–	87.89	–	–	–	–	91.40
VII., . .	86.60	–	–	–	–	89.68	–	–	–	93.36
VIII., . .	87.24	–	–	–	–	–	87.31	–	–	95.12

Sheep III.

Periods.	Hay.	Buffalo Gluten Feed.	New-process Linseed Meal.	Old-process Linseed Meal.	Spring Wheat Bran.	Winter Wheat Bran.	Wheat Middlings.	Waste.	Manure.
I., ...	85.50	–	–	–	–	–	–	74.28	92.75
III., ...	85.04	–	–	–	–	–	–	–	91.33
IV., ...	87.73	–	88.28	–	–	–	–	–	94.10
V., ...	86.23	–	–	87.28	–	–	–	–	94.67
VIII., ...	87.24	–	–	–	87.31	–	–	–	95.04

Sheep IV.

Periods.	Hay.	Buffalo Gluten Feed.	New-process Linseed Meal.	Old-process Linseed Meal.	Spring Wheat Bran.	Winter Wheat Bran.	Wheat Middlings.	Waste.	Manure.
I., ...	85.50	–	–	–	–	–	–	–	92.60
II., ...	88.05	90.00	–	–	–	–	–	–	91.00
III., ...	85.04	–	–	–	–	–	–	–	90.87
V., ...	87.73	–	–	88.00	–	–	–	–	94.58
IX., ...	86.23	–	–	–	–	86.49	–	–	95.60
X., ...	87.24	–	–	–	–	–	86.94	–	95.13

Composition of Feed Stuffs.

[Dry Matter.]

	Crude Ash (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Hay (*a*),	6.58	30.33	3.48	11.10	48.51
Hay (*b*),	7.83	32.74	3.08	10.79	45.56
Buffalo gluten feed,	0.78	8.38	14.29	26.35	50.20
New-process linseed meal,	5.84	8.59	4.01	40.40	41.16
Old-process linseed meal,	6.97	8.21	8.27	36.75	39.80
Corn cobs,	1.92	27.17	1.28	3.86	65.77
Dried brewers' grains,	3.59	14.52	7.81	22.99	51.09
Spring wheat bran,	6.13	11.48	5.40	17.60	59.39
Winter wheat bran,	6.24	9.32	4.57	17.04	62.83
Wheat middlings,	1.50	3.53	6.10	21.06	67.81
Waste from Sheep II.,*	15.07	27.78	2.97	11.84	42.34
Waste from Sheep II.,†	12.85	28.47	2.93	11.28	44.48
Waste from Sheep III.,*	14.68	18.02	3.79	14.98	48.53

* Period I. † Period II.

Composition of the Fœces.

[Dry Matter.]

Sheep I.

	Crude Ash (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Period III.					
Hay,	11.13	31.66	3.79	10.25	43.17
Period VI.					
Hay, new-process linseed meal and corn cob,	8.28	27.53	2.62	11.37	50.20
Period VII.					
Hay and dried brewers' grains,	11.99	25.52	2.82	11.55	48.12
Period X.					
Hay and wheat middlings,	11.80	27.89	3.75	11.83	44.73

Sheep II.

	Crude Ash (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Period I.					
Hay,	11.99	28.72	3.81	10.35	45.13
Period II.					
Hay and Buffalo gluten feed,	11.39	26.64	5.49	11.57	44.91

SHEEP II.—*Concluded.*

	Crude Ash (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Period III.					
Hay, ...	10.33	32.16	3.62	10.06	43.83
Period IV.					
Hay and new-process linseed meal, .	12.02	30.50	3.35	12.81	41.32
Period V.					
Hay and old-process linseed meal, .	12.29	30.05	3.45	12.00	42.21
Period VI.					
Hay, new-process linseed meal and corn cob, ...	8.77	26.63	2.60	11.07	50.93
Period VII.					
Hay and dried brewers' grains, . .	11.30	26.68	3.02	10.66	48.34
Period VIII.					
Hay and spring-wheat bran, . .	11.57	29.65	3.58	10.16	45.04

SHEEP III.

	Crude Ash (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Period I.					
Hay, ...	10.30	27.48	4.83	10.62	46.77
Period III.					
Hay, ...	11.28	31.47	3.65	10.69	42.91
Period IV.					
Hay and new-process linseed meal, .	12.68	28.89	3.41	13.06	41.96
Period V.					
Hay and old-process linseed meal, .	12.32	28.84	4.11	11.13	43.60
Period VIII.					
Hay and spring-wheat bran, . .	13.46	29.01	3.62	10.10	43.81

SHEEP IV.

	Crude Ash (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Period I.					
Hay, ...	10.99	27.72	4.50	10.43	46.36
Period II.					
Hay and Buffalo gluten feed, . .	9.21	26.90	6 22	12.42	45.25
Period III.					
Hay, ...	11.50	31.17	3.68	10.50	43.15
Period V.					
Hay and old-process linseed meal, .	11.92	28.31	3.80	12.56	43.41
Period IX.					
Hay and winter wheat bran, . .	12.80	25.92	4.15	10.61	46.52
Period X.					
Hay and wheat middlings, . . .	12.33	28.88	4.25	11.54	43.00

Tables showing Food fed and Water drank Daily, the Daily Amount of Manure and Urine excreted and the Temperature of the Stables.

PERIOD I. SHEEP II.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

DATE.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
March 31, . .	45.0	900	90.0	34.30	1,106	1.0303	1,915
April 1, . .	43.0	882	88.2	34.61	1,102	1.0331	1,855
2, . .	46.0	693	69.3	27.04	1,017	1.0337	1,820
3, . .	36.0	869	86.9	33.69	977	1.0356	1,650
4, . .	45.0	711	71.1	28.84	1,071	1.0342	1,532
5, . .	50.0	776	77.6	31.54	1,054	1.0340	1,780
6, . .	44.0	817	81.7	34.02	1,003	1.0358	1,480
Averages, .	44.1	807	80.7	32.06	1,047	1.0338	1,719

Weight of animal at beginning of period, ... 110.75 lbs.
Weight of animal at end of period, ... 110.75 "

PERIOD I. SHEEP III.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

DATE.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
May 9, . .	64.0	918	91.8	32.29	1,033	1.0301	1,753
10, . .	69.5	817	81.7	31.98	1,073	1.0324	2,350
11, . .	72.5	806	80.6	32.59	893	1.0340	2,645
12, . .	72.5	757	75.7	30.97	1,108	1.0291	3,153
13, . .	60.0	653	65.3	26.78	917	1.0344	2,725
14, . .	64.0	719	71.9	29.15	1,104	1.0306	1,675
15, . .	69.5	846	84.6	32.45	878	1.0321	1,978
Averages, .	67.4	788	78.8	30.89	1,009	1.0318	2,326

Weight of animal at beginning of period, ... 104.50 lbs.
Weight of animal at end of period, ... 105.25 "

* The amount of urine here reported includes the water used to wash the inside of the rubber funnel. This amounted to 194.3 grams daily.

Period I. Sheep IV.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

Date.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
May 9, . .	64.0	783	78.3	30.04	1,319	1.0239	1,617
10, . .	69.5	928	92.8	33.59	1,282	1.0266	2,332
11, . .	72.5	852	85.2	32.74	1,183	1.0272	2,395
12, . .	72.5	818	81.8	31.92	1,613	1.0231	1,438
13, . .	60.0	792	79.2	32.93	1,343	1.0259	2,415
14, . .	64.0	753	75.3	30.41	1,291	1.0262	1,850
15, . .	69.5	803	80.3	32.72	1,429	1.0268	2,155
Averages, .	67.4	818	81.8	32.05	1,351	1.0257	2,027

Weight of animal at beginning of period, ... 102.25 lbs.
Weight of animal at end of period, ... 101.50 "

Period II. Sheep II.

[Fodder consumed daily: 600 grams hay, 300 grams Buffalo gluten feed and 5 grams salt.]

Date.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
April 15, . .	44.5	897	89.7	35.07	1,141	1.0310	1,950
16, . .	49.0	781	78.1	31.26	1,004	1.0254	1,763
17, . .	43.0	807	80.7	30.33	–	–	1,787
18, . .	46.0	704	70.4	24.43	901	1.0323	1,905
19, . .	46.5	724	72.4	27.67	1,180	1.0257	2,062
20, . .	43.5	709	70.9	26.77	1,150	1.0270	1,726
Averages, .	45.4	770	77.0	29.26	1,075	1.0283	1,866

Weight of animal at beginning of period, ... 111.00 lbs.
Weight of animal at end of period, ... 110.75 "

* See foot-note on page 157.

Period II. Sheep IV.

[Fodder consumed daily: 600 grams hay, 250 grams Buffalo gluten feed and 5 grams salt.]

Date.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
June 10, . .	79.5	833	83.3	26.45	-	-	-
11, . .	82.0	781	78.1	26.51	1,309	1.0195	3,316
12, . .	75.5	753	75.3	26.85	1,470	1.0125	3,350
13, . .	72.5	629	62.9	26.79	1,000	1.0260	2,541
14, . .	77.0	689	68.9	27.82	-	-	2,193
15, . .	80.0	743	74.3	28.95	1,512	1.0183	3,154
Averages, .	77.8	738	73.8	27.23	1,323	1.0191	2,911

Weight of animal at beginning of period, ... 102.50 lbs.
Weight of animal at end of period, ... 104.50 "

Period III. Sheep I.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

Date.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
September 25, .	60	975.0	97.5	35.69	1,548	1.0190	2,248
26, .	56	974.0	97.4	39.06	1,831	-	2,435
27, .	50	867.0	86.7	35.88	1,451	1.0229	1,975
28, .	58	861.0	86.1	36.86	1,716	1.0191	2,395
29, .	52	823.0	82.3	35.47	1,816	1.0209	1,932
30, .	57	869.0	86.9	37.03	1,982	1.0191	2,406
October 1, .	55	863.0	86.3	38.74	1,773	1.0180	2,083
Averages, .	57	890.3	89.03	36.96	1,731	1.0132	2,211

Weight of animal at beginning of period, ... 94.00 lbs.
Weight of animal at end of period,. . . . . . 92.75 "

* See foot-note on page 157.

PERIOD III. SHEEP II.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

DATE.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
September 19, .	60	770.0	77.00	37.57	1,165	1.0304	1,740
20, .	70	745.0	74.50	35.89	1,114	1.0295	1,775
21, .	61	832.0	83.20	39.80	–	–	1,279
22, .	58	867.0	86.70	30.92	–	–	1,525
23, .	60	734.0	73.40	34.58	1,314	1.0285	1,510
24, .	62	775.0	77.50	36.60	1,135	1.0318	–
25, .	60	824.0	82.40	38.35	1,201	1.0286	–
Averages, .	62	792.4	79.24	37.53	1,186	1.0297	1,566

Weight of animal at beginning of period, ... 98.75 lbs.
Weight of animal at end of period, ... 98.50 "

PERIOD III. SHEEP III.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

DATE.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
September 19, .	60	753.0	75.3	37.72	943	1.0344	1,077
20, .	70	764.0	76.4	37.59	896	1.0342	1,685
21, .	61	798.0	79.8	38.55	916	1.0333	1,875
22, .	58	896.0	89.6	33.38	1,092	1.0314	1,687
23, .	60	816.0	81.6	35.84	1,010	1.0330	1,603
24, .	62	787.0	78.7	32.46	976	1.0329	–
25, .	60	857.0	85.7	39.54	1,090	1.0335	–
Averages, .	62	810.1	81.01	37.15	989	1.0333	1,585

Weight of animal at beginning of period, ... 94 lbs.
Weight of animal at end of period, ... 95 "

* See foot-note on page 157.

Period III. Sheep IV.

[Fodder consumed daily: 900 grams hay and 5 grams salt.]

Date.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
September 19, .	60	949.0	94.9	42.23	1,198	1.0291	1,835
20, .	70	782.0	78.2	35.68	1,375	1.0262	1,930
21, .	61	827.0	82.7	37.98	1,334	-	1,806
22, .	58	759.0	75.9	35.61	1,328	1.0259	1,653
23, .	60	722.0	72.2	34.11	1,321	1.0252	1,603
24, .	62	794.0	79.4	38.32	1,248	1.0270	-
25, .	60	745.0	74.5	36.31	1,555	1.0201	-
Averages, .	62	796.9	79.7	37.18	1,337	1.0256	1,765

Weight of animal at beginning of period, ... 102.00 lbs.
Weight of animal at end of period, ... 102.25 "

Period IV. Sheep II.

[Fodder consumed daily: 600 grams hay, 250 grams new-process linseed meal and 5 grams salt.]

Date.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
November 6, .	47.0	742	74.2	31.25	1,141	1.0330	1,295
7, .	46.0	743	74.3	29.34	1,156	1.0337	1,454
8, .	38.0	771	77.1	30.19	1,025	1.0359	1,481
9, .	47.5	825	82.5	30.07	1,001	1.0354	1,320
10, .	43.5	819	81.9	29.24	954	1.0387	1,254
11, .	44.5	819	81.9	28.02	943	1.0379	1,843
12, .	40.0	855	85.5	29.80	1,044	1.0364	1,565
Averages, .	43.8	796	79.6	29.70	1,038	1.0359	1,459

Weight of animal at beginning of period, ... 99.25 lbs.
Weight of animal at end of period, ... 100.25 "

* See foot-note on page 157.

PERIOD IV. SHEEP III.

[Fodder consumed daily: 600 grams hay, 250 grams new-process linseed meal and 5 grams salt.]

DATE.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
November 6, .	47.0	655	65.5	29.68	1,108	1.0358	1,125
7, .	46.0	739	73.9	31.35	1,079	1.0346	1,120
8, .	38.0	640	64.0	28.17	982	1.0377	1,381
9, .	47.5	644	64.4	27.93	1,069	1.0349	1,205
10, .	43.5	676	67.6	27.88	1,140	1.0338	1,336
11, .	44.5	653	65.3	28.12	1,054	1.0379	720
12, .	40.0	698	69.8	29.04	1,001	1.0366	1,760
Averages, .	43.8	672	67.2	28.88	1,062	1.0359	1,235

Weight of animal at beginning of period, ... 95.75 lbs.
Weight of animal at end of period, ... 96.25 "

PERIOD V. SHEEP II.

[Fodder consumed daily: 600 grams hay, 250 grams old-process linseed meal and 5 grams salt.]

DATE.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
November 20, .	41.5	811	81.1	30.45	1,072	1.0350	393
21, .	35.0	716	71.6	28.00	839	1.0420	1,795
22, .	45.0	751	75.1	30.98	866	1.0400	1,368
23, .	46.0	746	74.6	30.60	955	1.0415	1,081
24, .	38.0	668	66.8	28.76	880	1.0405	1,293
25, .	37.0	656	65.6	27.97	956	1.0420	1,204
26, .	37.0	837	83.7	34.24	944	1.0400	1,148
Averages, .	40.1	741	74.1	30.14	930	1.0401	1,183

Weight of animal at beginning of period, ... 100.25 lbs.
Weight of animal at end of period, ... 99.50 "

* See foot-note on page 157.

PERIOD V. SHEEP III.

[Fodder consumed daily: 600 grams hay, 250 grams old-process linseed meal and 5 grams salt.]

DATE.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
November 20, .	41.5	660	66.0	29.15	974	1.0410	728
21, .	35.0	617	61.7	27.54	867	1.0405	1,715
22, .	45.0	637	63.7	27.57	951	1.0410	1,110
23, .	46.0	694	69.4	30.23	990	1.0400	1,499
24, .	38.0	543	54.3	25.88	1,191	1.0310	1,222
25, .	37.0	647	64.7	28.68	987	1.0390	697
26, .	37.0	682	68.2	29.18	1,133	1.0340	1,017
Averages, .	40.1	640	64.0	28.32	1,013	1.0381	1,141

Weight of animal at beginning of period, ... 95.50 lbs.
Weight of animal at end of period, ... 96.50 "

PERIOD V. SHEEP IV.

[Fodder consumed daily: 600 grams hay, 250 grams old-process linseed meal and 5 grams salt.]

DATE.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
November 6, .	47.0	752	75.2	29.29	1,376	1.0254	1,954
7, .	46.0	762	76.2	29.31	1,610	1.0216	1,731
8, .	38.0	846	84.6	33.02	1,163	1.0295	1,113
9, .	47.5	737	73.7	28.05	1,150	1.0292	1,427
10, .	43.5	809	80.9	30.95	1,174	1.0301	1,390
11, .	44.5	739	73.9	30.73	1,235	1.0296	1,450
12, .	40.0	645	64.5	25.99	1,271	1.0289	1,825
Averages, .	43.8	756	75.6	29.62	1,283	1.0278	1,556

Weight of animal at beginning of period, ... 102.75 lbs.
Weight of animal at end of period, ... 104.00 "

* See foot-note on page 157.

PERIOD VI. SHEEP I.

[Fodder consumed daily: 450 grams hay, 400 grams corn cobs, 250 grams new-process linseed meal and 5 grams salt.]

DATE.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
October 13,	61	942.0	94.2	36.65	1,332	1.0227	2,428
14,	68	956.0	95.6	38.71	1,074	1.0274	2,320
15,	58	1,032.0	103.2	39.12	1,132	1.0276	1,875
16,	50	918.0	91.8	35.57	971	1.0315	2,330
17,	54	1,127.0	112.7	41.68	967	1.0313	1,362
18,	56	1,019.0	101.9	35.87	1,024	1.0286	1,605
19,	51	1,142.0	114.2	39.66	1,045	1.0280	1,953
Averages,	57	1,019.4	101.9	38.18	1,078	1.0282	1,982

Weight of animal at beginning of period, ... 92.75 lbs.
Weight of animal at end of period, ... 94.75 "

PERIOD VI. SHEEP II.

[Fodder consumed daily: 400 grams hay, 400 grams corn cobs, 200 grams new-process linseed meal and 5 grams salt.]

DATE.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
October 6,	59	829.0	82.9	35.33	726.0	1.0337	2,018
7,	67	1,004.0	100.4	39.92	857.0	1.0319	1,852
8,	61	946.0	94.6	33.39	810.0	1.0320	1,510
9,	65	999.0	99.9	35.86	-	-	1,765
10,	61	1,076.0	107.6	36.07	739.0	1.0357	1,696
11,	61	1,040.0	104.5	34.80	751.0	1.0345	2,080
12,	70	1,229.0	122.9	38.69	780.0	1.0374	1,070
Averages,	63	1,018.3	101.8	36.29	777.1	1.0342	1,713

Weight of animal at beginning of period, ... 95.75 lbs.
Weight of animal at end of period, ... 97.00 "

* See foot-note on page 157.

Period VII. Sheep I.

[Fodder consumed daily: 500 grams hay, 400 grams dried brewers' grains and 5 grams salt.]

Date.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
November 24, .	38.0	892	89.2	34.92	1,384	1.0180	2,392
25, .	37.0	875	87.5	33.61	1,437	1.0190	1,887
26, .	37.0	995	99.5	36.02	1,693	1.0170	1,515
27, .	30.0	787	78.7	30.67	1,370	1.0210	2,363
28, .	51.0	883	88.3	32.62	1,179	1.0205	963
29, .	43.5	955	95.5	36.93	1,157	1.0210	1,846
30, .	47.0	1,014	101.4	36.66	1,659	1.0160	2,065
Averages, .	40.5	914	91.4	34.49	1,411	1.0189	1,862

Weight of animal at beginning of period, ... 96.00 lbs.
Weight of animal at end of period, ... 95.75 "

Period VII. Sheep II.

[Fodder consumed daily: 500 grams hay, 400 grams dried brewers' grains and 5 grams salt.]

Date.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
October 21, .	60.0	908.0	90.8	35.91	791	1.0307	1,560
22, .	52.0	939.0	93.9	38.44	780	1.0311	1,882
23, .	62.0	856.0	85.6	35.09	801	1.0288	1,328
24, .	64.0	825.0	82.5	35.95	786	1.0298	1,390
25, .	62.0	911.0	91.1	38.74	787	1.0301	1,910
26, .	47.0	897.0	89.7	35.41	911	1.0286	1,485
27, .	–	1,028.0	102.8	39.29	835	1.0292	1,133
Averages, .	57.8	909.1	90.91	36.98	813	1.0298	1,527

Weight of animal at beginning of period, ... 99.00 lbs.
Weight of animal at end of period, ... 100.25 "

* See foot-note on page 157.

PERIOD VIII. SHEEP II.

[Fodder consumed daily: 600 grams hay, 300 grams spring-wheat bran and 5 grams salt.]

DATE.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
December 5, .	26	842.0	84.2	30.21	1,157	1.0280	1,703
6, .	32	983.0	98.3	35.64	1,020	1.0310	897
7, .	33	854.0	85.4	31.48	894	1.0360	1,897
8, .	30	1,065.0	106.5	36.81	936	1.0295	1,181
9, .	29	1,107.0	110.7	37.40	840	1.0360	1,407
10, .	37	1,106.0	110.6	36.01	908	1.0340	1,484
11, .	32	1,160.0	116.0	38.13	915	–	1,425
Averages, .	31	1,016.7	101.7	35.10	953	1.0324	1,428

Weight of animal at beginning of period, ... 99.75 lbs.
Weight of animal at end of period, ... 100.25 "

PERIOD VIII. SHEEP III.

[Fodder consumed daily: 600 grams hay, 300 grams spring-wheat bran and 5 grams salt.]

DATE.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
December 5, .	26.0	750	75.0	29.04	911	1.0345	1,105
6, .	32.0	988	98.8	38.69	973	1.0345	40
7, .	33.5	918	91.8	34.30	754	1.0400	1,597
8, .	30.5	965	96.5	35.09	744	1.0345	1,709
9, .	29.0	965	96.5	35.07	796	1.0370	880
10, .	37.5	881	88.1	33.13	880	1.0380	1,318
11, .	32.5	1,000	100.0	37.36	897	–	1,020
Averages, .	31.6	924	92.4	34.67	851	1.0364	1,096

Weight of animal at beginning of period, ... 98.25 lbs.
Weight of animal at end of period, ... 97.75 "

* See foot-note on page 157.

Period IX. Sheep IV.

[Fodder consumed daily: 600 grams hay, 300 grams winter-wheat bran and 5 grams salt.]

Date.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
November 21, .	35.0	982	98.2	32.87	1,114	1.0239	1,928
22, .	45.0	924	92.4	30.76	1,235	1.0220	1,790
23, .	46.0	1,246	124.6	41.04	1,194	1.0260	1,738
24, .	38.0	706	70.6	25.10	1,081	1.0270	2,178
25, .	37.0	973	97.3	33.57	1,182	1.0260	1,151
26, .	37.0	1,258	125.8	32.91	1,156	1.0260	1,443
27, .	30.0	1,083	108.3	34.71	1,309	1.0250	1,530
Averages, .	38.3	1,025	102.5	32.99	1,182	1.0251	1,680

Weight of animal at beginning of period, ... 105.25 lbs.
Weight of animal at end of period, ... 104.50 "

Period X. Sheep I.

[Fodder consumed daily: 600 grams hay, 300 grams wheat middlings and 5 grams salt.]

Date.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
December 8, .	30.5	825	82.5	29.24	1,606	1.0165	2,271
9, .	29.0	934	93.4	32.60	1,929	1.0145	2,237
10, .	37.5	912	91.2	29.48	1,416	1.0140	2,411
11, .	32.5	877	87.7	30.16	1,799	-	2,325
12, .	29.0	880	88.0	29.73	1,809	1.0160	2,317
13, .	23.5	970	97.0	33.37	-	-	2,345
14, .	15.0	797	79.7	26.51	1,124	1.0230	-
Averages, .	28.1	885	88.5	30.16	1,614	1.0168	2,318

Weight of animal at beginning of period, ... 95.00 lbs.
Weight of animal at end of period, ... 93.75 "

* See foot-note on page 157.

PERIOD X. SHEEP IV.

[Fodder consumed daily: 600 grams hay, 300 grams wheat middlings and 5 grams salt.]

DATE.	Stable Temperature (Fahr.).	Manure excreted Daily.	Sample preserved.	Sample Air Dry.	Urine* excreted Daily, plus Wash Water.	Specific Gravity of Urine.	Water consumed Daily.
1893.	Degrees.	Grams.	Grams.	Grams.	Grams.		Grams.
December 6, .	32.0	774	77.4	26.20	964	1.0260	1,479
7, .	33.5	723	72.3	25.88	1,354	1.0240	1,285
8, .	30.5	860	86.0	31.53	932	1.0260	1,054
9, .	29.0	784	78.4	30.30	962	1.0295	1,326
10, .	37.5	741	74.1	27.70	791	1.0400	1,077
11, .	32.5	786	78.6	28.92	975	–	1,581
12, .	29.0	712	71.2	27.05	983	1.0300	964
Averages, .	30.6	769	76.9	28.23	994	1.0293	1,267

Weight of animal at beginning of period, ... 103.50 lbs.
Weight of animal at end of period, ... 103.25 "

* See foot-note on page 157.

The data furnished in the preceding tables enable us to calculate the *coefficients of digestibility* for the various foods, which will be found in the following pages.

English Hay (a). Period I.

SHEEP II.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
	Grams.	Grams.	Grams.	Grams.	Grams.
900 grams hay fed, . . .	758.16	229.98	26.38	84.16	367.79
11.43 grams waste,* . .	8.88	2.47	0.26	1.05	3.76
Total consumed, . . .	749.28	227.51	26.12	83.11	364.03
320.06 grams manure air dry,	294.67	84.62	11.22	30.49	132.99
Grams digested, . . .	454.61	142.89	14.90	52.62	231.04
Per cent. digested, . . .	60.67	62.80	57.04	63.31	63.46

SHEEP III.

900 grams hay fed, . . .	769.50	233.39	26.77	85.42	373.30
20.71 grams waste,* . .	15.38	2.77	0.58	2.30	7.48
Total consumed, . . .	754.12	230.62	26.19	83.12	365.82
308.9 grams manure air dry, .	286.50	78.73	13.84	30.43	134.00
Grams digested, . . .	467.62	151.89	12.35	52.69	231.82
Per cent. digested, . . .	62.00	65.86	47.15	63.39	63.37

SHEEP IV.

900 grams hay fed, . . .	769.50	233.39	26.77	85.42	373.30
320.5 grams manure air dry, .	296.78	82.27	13.36	30.95	137.58
Grams digested, . . .	472.72	151.12	13.41	54.47	235.72
Per cent. digested, . . .	61.43	64.73	50.09	63.76	63.14
Average per cent. digested, .	**61.37**	**64.46**	**51.43**	**63.49**	**63.32**

Average nutritive ratio of ration for three sheep, 1 : 7.79.

* It will be noticed that in Period I., Sheep II. and III., and in Period II., Sheep II., small amounts of hay (the coarser portions) were not consumed; these amounts were carefully collected, weighed, dry matter tests and complete analyses made.

Buffalo Gluten Feed. Period II.

SHEEP II.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
	Grams.	Grams.	Grams.	Grams.	Grams.
600 grams hay (*a*) fed, . .	501.06	151.97	17.44	55.62	243.06
12.5 grams waste,* . . .	9.71	2.76	0.28	1.10	4.32
Hay consumed, . . .	491.35	149.21	17.16	54.52	238.74
300 grams Buffalo gluten feed,	271.77	22.77	38.83	71.61	136.43
Total consumed, . . .	763.12	171.98	55.99	126.13	375.17
292.55 grams manure air dry,	259.73	69.19	14.26	30.06	116.65
Grams digested, . . .	503.39	102.79	41.73	96.07	258.52
Minus 600 grams hay digested,	298.10	93.70	9.79	34.52	151.50
Buffalo gluten feed digested, .	205.29	9.09	31.94	61.55	107.02
Per cent. digested, . . .	75.53	39.92	82.25	85.97	78.44

* See note on preceding page.

SHEEP IV.

600 grams hay fed, . . .	528.30	160.23	18.38	58.65	256.28
250 grams Buffalo gluten feed,	225.00	18.86	32.15	59.28	112.95
Total consumed, . . .	753.30	179.09	50.53	117.93	369.23
272.28 grams manure air dry,	247.77	66.65	15.41	30.77	112.12
Total digested, . . .	505.53	112.44	35.12	87.16	257.11
Minus 600 grams hay digested,	324.54	103.71	9.21	37.39	161.82
Buffalo gluten feed digested, .	180.99	8.73	25.91	49.77	95.29
Per cent. digested, . . .	80.44	46.28	80.58	83.94	84.37
Average per cent. two sheep digested, ...	**77.98**	**43.10**	**81.41**	**84.95**	**81.40**

Average nutritive ratio of ration for two sheep, 1 : 5.03.

English Hay (b). Period III.

SHEEP I.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
	Grams.	Grams.	Grams.	Grams.	Grams.
900 grams hay fed, . . .	765.36	250.58	23.57	82.58	348.69
369.3 grams manure air dry, .	337.95	107.00	12.81	34.64	145.89
Amount digested, . . .	427.41	143.58	10.76	47.94	202.80
Per cent. digested, . . .	55.84	57.30	45.65	58.05	58.16

SHEEP II.

900 grams hay fed, . . .	765.36	250.58	23.57	82.58	348.69
375.3 grams manure air dry, .	343.62	110.51	12.44	34.57	150.61
Amount digested, . . .	421.74	140.07	11.13	48.01	198.08
Per cent. digested, . . .	55.10	55.90	47.22	58.13	56.80

SHEEP III.

900 grams hay fed, . . .	765.36	250.58	23.57	82.58	348.69
371.54 grams manure air dry,	339.33	106.78	12.38	36.27	145.60
Amount digested, . . .	426.03	143.80	11.19	46.31	203.09
Per cent. digested, . . .	55.56	57.38	47.47	56.08	58.24

SHEEP IV.

900 grams hay fed, . . .	765.36	250.58	23.57	82.58	348.69
371.77 grams manure air dry,	337.83	105.30	12.43	35.47	145.77
Amount digested, . . .	427.53	145.28	11.14	47.11	202.92
Per cent. digested, . . .	55.86	57.98	47.26	57.04	58.19
Average per cent. four sheep digested, ...	**55.57**	**57.14**	**46.90**	**57.32**	**57.85**

Average nutritive ratio of ration for three sheep, 1 : 7.89.

By feeding the following grains in connection with English hay (*b*) we are enabled to find their coefficients of digestibility.

New-process Linseed Meal. Period IV.

SHEEP II.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
	Grams.	Grams.	Grams.	Grams.	Grams.
600 grams hay fed, . . .	526.38	172.34	16.21	56.79	239.82
250 grams new-process linseed meal, ...	220.70	18.96	8.85	89.16	90.84
Total consumed, . . .	747.08	191.30	25.06	145.95	330.66
297.01 grams manure air dry,	280.76	85.63	9.40	35.96	116.01
Amount digested, . . .	466.32	105.67	15.66	109.99	214.65
Minus 600 grams hay digested,	290.06	96.33	7.65	33.02	136.24
Remains linseed meal digested,	176.26	9.34	8.01	76.97	78.41
Per cent. digested, . . .	79.86	49.24	90.50	86.32	86.31

SHEEP III.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
Total consumed, as above, .	747.08	191.30	25.06	145.95	330.66
288.81 grams manure air dry,	271.77	78.52	9.27	35.49	114.04
Total digested, . . .	475.31	112.78	15.79	110.46	216.62
Minus 600 grams hay digested,	293.01	98.90	7.69	31.85	139.67
Remains linseed meal digested,	182.30	13.88	8.10	78.61	76.95
Per cent. digested, . . .	82.60	73.21	91.52	88.16	84.71
Average per cent. two sheep digested, ...	**81.23**	**61.23**	**91.01**	**87.24**	**85.51**

Average nutritive ratio of ration for two sheep, 1 : 3.30.

Old-process Linseed Meal. Period V.

SHEEP II.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
	Grams.	Grams.	Grams.	Grams.	Grams.
600 grams hay fed, . . .	517.38	169.42	15.94	55.83	235.72
250 grams old-process linseed meal, ...	218.18	17.91	18.04	80.18	86.83
Total consumed, . . .	735.56	187.33	33.98	136.01	322.55
301.43 grams manure air dry, .	285.76	85.87	9.86	34.29	120.62
Total digested, . . .	449.80	101.46	24.12	101.72	201.93
Minus 600 grams hay digested,	285.10	94.69	7.52	32.46	133.91
Remains old-process linseed meal digested, . . .	164.70	6.77	16.60	69.26	68.02
Per cent. digested, . . .	75.48	37.80	92.01	86.38	78.33

SHEEP III.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
Total consumed, as above, .	735.56	187.33	33.98	136.01	322.55
283.20 grams manure air dry,	268.10	77.32	11.02	29.84	116.89
Total digested, . . .	467.46	110.01	22.96	106.17	205.66
Minus 600 grams hay digested,	288.00	97.21	7.57	31.31	137.29
Remains old-process linseed meal digested, . . .	179.46	12.80	15.39	74.86	68.37
Per cent. digested, . . .	82.25	71.47	85.30	93.36	78.73

SHEEP IV.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
600 grams hay consumed, .	526.38	172.34	16.21	56.79	239.82
250 grams old-process linseed meal, ...	220.00	18.06	18.19	80.85	87.56
Total consumed, . . .	746.38	190.40	34.40	137.64	327.38
296.2 grams manure air dry, .	280.20	79.32	10.65	35.19	121.64
Total digested, . . .	466.18	111.08	23.75	102.45	205.74
Minus 600 grams hay digested,	294.04	99.92	7.66	32.40	139.56
Remains old-process linseed meal digested, . . .	172.14	11.16	16.09	70.05	66.18
Per cent. digested, . . .	78.24	61.79	88.45	86.64	75.58
Average per cent. three sheep digested, ...	**78.66**	**57.02**	**88.59**	**88.79**	**77.55**

Average nutritive ratio of ration for three sheep, 1 : 3.59.

Corn (Maize) Cobs. Period VI.

SHEEP I.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
	Grams.	Grams.	Grams.	Grams.	Grams.
450 grams hay fed, . . .	384.03	125.72	11.83	41.44	174.96
400 grams corn cobs, . .	351.56	95.51	4.50	13.57	231.21
250 grams new-process linseed meal, ...	220.25	18.92	8.83	88.98	90.65
Total consumed, . . .	955.84	240.15	25.16	143.99	496.82
381.8 grams manure air dry, .	353.05	97.19	9.25	40.14	177.23
Total digested, . . .	602.79	142.96	15.91	103.85	319.59
Minus 450 grams hay digested, ... Minus 250 grams new-process linseed meal digested, .	390.34	81.36	13.39	100.88	180.00
Remains corn cobs digested, .	212.45	61.60	2.52	2.97	139.59
Per cent. digested, . . .	60.43	64.50	56.00	21.88	60.37

SHEEP II.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
400 grams hay fed, . . .	334.48	109.50	10.30	36.09	152.39
400 grams corn cobs, . .	351.56	95.51	4.50	13.57	231.21
200 grams new-process linseed meal, ...	177.14	15.22	7.10	71.56	72.91
Total consumed, . . .	863.18	220.23	21.90	121.22	456.51
362.94 grams manure air dry,	331.73	88.34	8.62	36.72	168.95
Total digested, . . .	531.45	131.89	13.28	84.50	287.56
Minus 400 grams hay digested, Minus 200 grams new-process linseed meal digested, .	325.76	68.70	11.29	82.75	149.49
Remains corn cobs digested, .	205.69	63.19	1.99	1.75	138.07
Per cent. digested, . . .	58.51	66.16	44.22	12.89	59.71
Average per cent. two sheep digested, ...	**59.47**	**65.33**	**50.11**	**17.38**	**60.04**

Nutritive ratio of ration, Sheep I., 1 : 4.84; nutritive ratio of ration, Sheep II., 1 : 5.36.

Dried Brewers' Grains. Period VII.

SHEEP I.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
	Grams.	Grams.	Grams.	Grams.	Grams.
500 grams hay fed, . . .	433.00	141.76	13.34	46.72	197.27
400 grams brewers' grains, .	358.72	52.09	28.02	82.47	183.27
Total consumed, . . .	791.72	193.85	41.36	129.19	380.54
344.9 grams manure air dry, .	328.83	83.91	9.27	37.98	158.23
Total digested, . . .	462.89	109.94	32.09	91.21	222.31
Minus 500 grams hay digested,	241.79	81.23	6.09	27.12	114.73
Remains brewers' grains digested, ...	221.10	28.71	26.00	64.09	107.58
Per cent. digested, . . .	61.63	55.11	92.79	77.71	58.70

SHEEP II.

Total consumed, as above, .	791.72	193.85	41.36	129.19	380.54
355.47 grams manure air dry,	331.87	88.54	10.00	35.38	160.42
Total digested, . . .	459.85	105.31	31.36	93.81	220.12
Minus 500 grams hay digested,	238.59	79.24	6.30	27.16	112.05
Remains brewers' grains digested, ...	221.26	26.07	25.06	66.65	108.07
Per cent. digested, . . .	61.68	50.04	89.43	80.82	58.96
Average per cent. two sheep digested, ...	**61.65**	**52.57**	**91.11**	**79.26**	**57.83**

Average nutritive ratio of ration for two sheep, 1 : 4.40.

Spring Wheat Bran. Period VIII.

SHEEP II.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
	Grams.	Grams.	Grams.	Grams.	Grams.
600 grams hay fed, . . .	523.44	171.37	16.12	56.48	238.48
300 grams spring-wheat bran,	261.93	30.07	14.14	46.07	155.56
Total consumed, . . .	785.37	201.44	30.26	102.55	394.04
350.97 grams manure air dry,	333.84	98.98	11.95	33.92	150.36
Total digested, . . .	451.53	102.46	18.31	68.63	243.68
Minus 600 grams hay digested,	288.44	95.79	7.61	32.84	135.48
Remains spring-wheat bran digested, ...	163.09	6.67	10.70	35.79	108.20
Per cent. digested, . . .	62.26	22.18	75.67	77.68	69.55

SHEEP III.

Total consumed, as above, .	785.37	201.44	30.26	102.55	394.04
346.69 grams manure air dry,	329.49	95.58	11.93	33.28	144.35
Total digested, . . .	455.88	105.86	18.33	69.27	249.69
Minus 600 grams hay digested,	291.38	98.34	7.65	31.68	138.90
Remains spring-wheat bran digested, ...	164.50	7.52	10.68	37.59	110.79
Per cent. digested, . . .	62.80	0.25	75.53	81.59	71.22
Average per cent. two sheep digested, ...	**62.53**	**23.59**	**75.60**	**79.63**	**70.38**

Nutritive ratio of ration for two sheep, 1 : 5.75.

Winter-Wheat Bran. Period IX.

SHEEP IV.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
	Grams.	Grams.	Grams.	Grams.	Grams.
600 grams hay fed, . . .	517.38	169.39	15.94	55.82	235.72
300 grams winter-wheat bran,	259.47	24.18	11.86	44.22	163.03
Total consumed, . . .	776.86	193.57	27.80	100.04	398.75
329.94 grams manure air dry,	315.42	81.75	13.09	33.47	146.74
Total digested, . . .	461.43	111.82	14.71	66.57	252.01
Minus 600 grams hay digested,	289.01	98.21	7.53	31.84	137.18
Remains winter-wheat bran digested, ...	172.42	13.61	7.18	34.73	114.83
Per cent. digested, . . .	**66.45**	**56.28**	**60.54**	**78.54**	**70.43**

Nutritive ratio of ration, 1 : 6.02.

Wheat Middlings.

SHEEP I.

	Dry Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Extract Matter.
	Grams.	Grams.	Grams.	Grams.	Grams.
600 grams hay fed, . . .	523.44	171.37	16.12	56.48	238.48
300 grams wheat middlings, .	260.82	9.21	15.91	54.93	176.86
Total consumed, . . .	784.26	180.58	32.03	111.41	415.34
301.56 grams manure air dry,	284.64	79.39	10.67	33.67	127.32
Total digested, . . .	499.62	101.19	21.36	77.74	288.02
Minus 600 grams hay digested,	292.30	98.19	7.36	32.79	138.70
Remains wheat middlings digested, ...	207.32	3.00	14.00	44.95	149.32
Per cent. digested, . . .	79.48	32.57	87.99	81.83	84.43

SHEEP IV.

Total consumed, as above, .	784.26	180.58	32.03	111.41	415.34
282.26 grams manure air dry,	268.51	77.54	11.41	30.99	115.46
Total digested, . . .	515.75	103.04	20.62	80.42	299.88
Minus 600 grams hay digested,	292.40	99.35	7.62	32.22	138.78
Remains wheat middlings digested, ...	223.35	3.69	13.00	48.20	161.10
Per cent. digested, . . .	85.63	40.06	81.71	87.75	91.08
Average per cent. two sheep digested, ...	**82.55**	**36.31**	**84.85**	**84.79**	**87.75**

Average nutritive ratio of ration for both sheep, 1:5.61.

A *résumé* of the coefficients will be found on page 152.

A compilation of the results of all digestion experiments made in the United States will be found in the rear portion of this report.

VII.

NOTES ON FEEDING FARM HORSES.

1888–93.

Rations for Farm Horses.

The following data are presented in order to show how the horses kept at the station have been fed during the past few years. The two farm horses, Fan and Bess, do an average amount of work during the spring, summer and autumn. In the winter season the work is light. Molly, whose record first appears in January, 1892, has been used for driving and express work.

During the winter of 1892, when the horses had comparatively little to do, the grain rations were reduced one-third. The so-called provender consists of cracked corn and oats mixed in the proportion of four hundred pounds of corn to fifteen bushels of oats. The horses were weighed weekly, and the average monthly weights will be found in Table III. The horses have been in uniform good condition during the several years.

Table I. (Horses Fan, Bess and Molly.)

Ration.		Food consumed Daily (Pounds). Hay.	Wheat Bran.	Provender.	Nutritive Ratio.	Total Dry Matter (Pounds).	Total Digestible Matter (Pounds).	Cost per Day (Cents).
I.,	Aug., 1888, to June, 1889,	18.00	2.00	6.00	1:7.92	23.23	14.39	23.34
II.,	June, 1889, to Jan., 1892,	20.00	2.00	6.00	1:7.99	25.03	15.41	24.84
III.,	Jan., 1892, to May, 1892,	15.00	2.00	4.00	1:7.22	18.78	11.42	18.49
IV.,	May, 1892, to Jan., 1894,	15.00	3.00	6.00	1:7.81	21.43	13.26	22.09

The above table shows the daily rations fed during the several years, the nutritive ratios of the feed, the average

amount of dry matter and digestible matter consumed daily and the average daily cost of the rations.

The following table shows the pounds of digestible nutrients in Ration IV., as compared with Wolff's standard for horses of one thousand pounds live weight, doing average work and hard work: —

Table II.

	Digestible Protein (Pounds).	Digestible Fat (Pounds).	Digestible Carbohydrates (Pounds).	Total Digestible Matter (Pounds).	Nutritive Ratio.
Ration IV., ...	1.58	0.43	11.25	13.26	1:7.81
Wolff's standard, average work, ...	1.55	0.55	10.85	12.95	1:7.80
Wolff's standard, very hard work, ...	2.12	0.83	12.63	15.58	1:7.00

Table III., showing Average Monthly Weight of the Horses (Pounds).

Ration.	Year.	Name of Horse.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
I.,	1888,	Fan,	–	–	–	–	–	–	–	1,089	1,090	1,103	1,101	1,115
I.,	1888,	Bess,	–	–	–	–	–	–	–	1,107	1,115	1,115	1,116	1,126
I.,	1889,	Fan,	1,108	1,104	1,104	1,114	1,095	–	–	–	–	–	–	–
I.,	1889,	Bess,	1,109	1,092	1,101	1,123	1,116	–	–	–	–	–	–	–
II.,	1889,	Fan,	–	–	–	–	–	1,110	1,083	1,082	1,079	1,086	1,101	1,106
II.,	1889,	Bess,	–	–	–	–	–	1,129	1,108	1,095	1,108	1,103	1,118	1,109
II.,	1890,	Fan,	1,131	1,119	1,112	1,098	1,120	1,123	1,127	1,124	1,102	1,108	1,108	1,119
II.,	1890,	Bess,	1,120	1,126	1,119	1,110	1,119	1,118	1,129	1,134	1,125	1,121	1,126	1,107
II.,	1891,	Fan,	1,111	1,106	1,107	1,105	1,103	1,100	1,114	1,100	1,101	1,121	1,125	1,138
II.,	1891,	Bess,	1,110	1,077	1,099	1,097	1,109	1,115	1,126	1,120	1,117	1,126	1,137	1,144
III.,	1892,	Fan,	1,108	1,122	1,117	1,113	–	–	–	–	–	–	–	–
III.,	1892,	Molly,	1,062	1,063	1,063	1,038	–	–	–	–	–	–	–	–
III.,	1892,	Bess,	1,143	1,145	1,129	1,126	–	–	–	–	–	–	–	–
IV.,	1892,	Fan,	–	–	–	–	1,119	1,098	1,078	1,094	1,075	1,103	1,102	1,099
IV.,	1892,	Molly,	–	–	–	–	1,037	1,019	1,085	1,036	1,057	1,056	1,066	1,085
IV.,	1892,	Bess,	–	–	–	–	1,127	1,112	1,101	1,108	1,081	1,086	1,084	1,107
IV.,	1893,	Fan,	1,103	1,135	1,124	1,133	1,126	1,114	1,104	1,100	1,076	1,087	1,111	1,111
IV.,	1893,	Molly,	1,090	1,095	1,085	1,076	1,074	1,070	1,068	1,082	1,053	1,083	1,080	1,113
IV.,	1893,	Bess,	1,111	1,092	1,062	1,071	1,078	1,040	1,070	1,065	1,065	1,033	1,080	1,101

Remarks.

It will be noticed that the average weight of the horses has been well sustained by the various rations fed. Table III. makes this very clear. Slight variations are noted at times, due probably to the fact that the horses were obliged to do rather more than the average work for a short time.

Ration III., fed when the horses were doing very light work, proved sufficient to keep them in good condition, and costs several cents less per day than the others. Ration IV. gives very good results, and costs somewhat less than Rations I. and II. The cost of the several rations is based on an approximate average market cost of the several foods. This average will be found below. Ration IV. contains about the same amount of digestible nutrients as given by Wolff for horses doing average work.

Average Market Cost of the Various Foods fed.

Hay,	$15 00 per ton.
Wheat bran,	20 00 "
Cracked corn,	24 00 "
Oats (thirty-two pounds per bushel),	0 45 per bushel.

Average Composition of Fodder Stuffs.

	Hay.	Wheat Bran.	Provender.
Moisture at 100° C.,	10.15	10.49	12.16
Dry matter,	89.85	89.51	87.84
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	6.21	7.01	2.58
" cellulose,	32.15	10.89	6.96
" fat,	2.38	5.00	5.11
" protein,	9.67	17.78	12.25
Non-nitrogenous extract matter,	49.59	59.32	73.04
	100.00	100.00	100.00

PART II.

FIELD EXPERIMENTS.

C. A. Goessmann.

1. Field Experiments to ascertain the Effect of the Exclusion of Every Form of Nitrogen-containing Manurial Matter from the Fertilizer applied for the Production of a Grain Crop — Oats — on its Yield per Acre (Field A).
2. Field Experiments with Prominent Varieties of Grasses and Grass Mixtures under fairly Corresponding Circumstances and with Different Varieties of Potatoes (Field B).
3. Field Experiments regarding the Effect of Different Combinations of Commercial Fertilizers on the Yield of Some Prominent Garden Crops (Field C).
4. Observations regarding the Adaptation of a Variety of More or Less Reputed Fodder Plants new to our Section of the Country (Field D).
5. Field Experiments with Different Commercial Phosphates, to study the Economy of Using the Cheaper Natural Phosphates or the More Costly Acidulated Phosphates (Field F).
6. Field Experiments to show the Effect of Barn-yard Manure on the Yield of Corn (Field G).
7. Field Experiments to determine the Effect of Various Fertilizer Mixtures on Leguminous and Grain Crops (East Field).
8. Observations on Permanent Grass Lands — Meadows.
9. Report on General Farm Work.
10. Observations on Special Fertilization with Reference to some Prominent Industrial Crops, Fruits and Garden Vegetables.

1. FIELD EXPERIMENTS CARRIED ON FOR THE PURPOSE OF ASCERTAINING THE EFFECT OF THE EXCLUSION OF EVERY FORM OF NITROGEN-CONTAINING MANURIAL MATTER FROM THE FERTILIZER APPLIED FOR THE PRODUCTION OF OATS ON THE YIELD, AS COMPARED WITH THE RESULTS OBTAINED WHEN A LIBERAL AMOUNT OF VARIOUS NITROGEN-CONTAINING MANURIAL SUBSTANCES IS APPLIED UNDER OTHERWISE CORRESPONDING CIRCUMSTANCES FOR THE SAME PURPOSE.

Field A.

The unbroken record of this field extends over more than twenty years. The systematic treatment of the soil, as far as suitable modes of cultivation and of manuring are concerned, was introduced during the season of 1883–84. The subdivision of the entire area into eleven plats (one-eighth of an acre each), of a uniform size and shape, one hundred and thirty feet long and thirty feet wide, with an unoccupied and unmanured space of five feet in width between adjoining plats, has been retained unaltered since 1884. A detailed statement of the particular aim and general management of our experiments, as well as of the results obtained in that connection from year to year, forms a prominent part of our contemporary printed annual reports, to which I have to refer for details.

Since 1889 the main object of observations upon the same field has been to study the influence of an entire exclusion of any additional nitrogen-containing manurial substance from the soil under cultivation, as well as of a definite additional supply of nitrogen in different forms of combination, on the character and yield of the crop selected for the trial. The treatment of the soil adopted in preceding years favored this new project for field observations, as may be noticed from the following remarks.

Several plats which for five preceding years did not receive any nitrogen compound for manurial purposes were retained in that state, to study the effect of an entire exclusion of nitrogen-containing manurial substances on the crop under

cultivation, while the remaining ones received as before a definite amount of nitrogen in the same form in which they had received it in preceding years; namely, either as sodium nitrate or as ammonium sulphate, or as organic nitrogenous matter in form of dried blood or of barn-yard manure. A corresponding amount of available nitrogen was applied in all these cases.

Aside from the difference regarding the nitrogen supply, all plats were treated alike. They each received without an exception a corresponding amount of available phosphoric acid and of potassium oxide. The phosphoric acid was supplied in form of dissolved bone-black, and the potassium oxide either in form of muriate of potash or of potash-magnesia sulphate.

Amount of Fertilizing Ingredients used Annually per Acre.

Plats 0, 1, 2, 3, 5, 6, 8, 10,	Nitrogen,	45 pounds.
	Phosphoric acid,	80 pounds.
	Potassium oxide,	125 pounds.
Plats 4, 7, 9,	Nitrogen,	none.
	Phosphoric acid,	80 pounds.
	Potassium oxide,	125 pounds.

One plat marked 0 received its main supply of phosphoric acid, potassium oxide and nitrogen in form of barn-yard manure; the latter was carefully analyzed before being applied, to determine the amount required to secure, as far as practicable, the desired corresponding proportion of the three essential fertilizing constituents. The deficiency in potassium oxide and phosphoric acid was supplied by potash-magnesia sulphate and dissolved bone-black. The fertilizer for this plat consisted of 800 pounds of barn-yard manure, 32 pounds of potash-magnesia sulphate and 18 pounds of dissolved bone-black.

The mechanical preparation of the soil, the incorporation of the manurial substances, — the general character of the latter being the same, — the seeding, cultivating and harvesting were carried on year after year in a like manner, and as far as practicable on the same day in case of every plat during the same year.

The subsequent tabular statement shows the annual application and special distribution of the manurial substances with reference to each plat since 1889. The fertilizers were in every case applied broadcast as early as circumstances permitted. They were well harrowed under before the seed was planted in rows by a seed drill.

PLATS.	Annual Supply of Manurial Substances.
Plat 0,	800 lbs. of barn-yard manure, 32 lbs. of potash-magnesia sulphate and 18 lbs. of dissolved bone-black.
Plat 1, .	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 2, .	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 3, .	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 4, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 5, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 6, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 7, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 8, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 9, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 10, .	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).

Cost of Fertilizers applied to Field A.

	Cost per Plat.	Cost per Acre.
Plat 0,	$2 28	$22 75
Plat 1,	1 99	19 90
Plat 2,	2 43	24 30
Plat 3,	2 09	20 90
Plat 4,	1 23	12 30
Plat 5,	2 46	24 58
Plat 6,	2 02	20 18
Plat 7,	1 23	12 30
Plat 8,	2 02	20 18
Plat 9,	1 23	12 30
Plat 10,	2 53	25 30

The above-described course of the general management of the experiment has been followed thus far for five consecutive years (1889–93, inclusive).

Kind of Crops raised.

Corn (maize), ... in 1889.
Oats, ... in 1890.
Rye, ... in 1891.
Soja bean, ... in 1892.
Oats, ... in 1893.

For details regarding earlier years (1889–92), see corresponding annual reports.

Summary of Four Years' Observations upon Field A (1889–92).

Number of Plat.	1889. Corn.	1890. Yield of Oats.					1891. Yield of Rye.					1892.
	Yield of Dry Fodder Corn (Pounds).	Crop (Pounds).	Percentage of Grain.	Percentage of Straw and Chaff.	Yield of Grain (Pounds).	Yield of Straw (Pounds).	Crop (Pounds).	Percentage of Grain.	Percentage of Straw and Chaff.	Yield of Grain (Pounds).	Yield of Straw (Pounds).	Yield of Green Soja Bean (Pounds).
Plat 0, .	–	315	38.10	61.90	120	195	470	30.21	69.79	142	328	2,210
Plat 1, .	648	362	35.36	64.64	128	234	570	27.02	72.98	154	416	2,290
Plat 2, .	577	365	35.34	64.66	129	236	525	25.52	74.48	134	391	2,290
Plat 3, .	618	345	33.62	66.38	116	229	475	27.37	72.63	130	345	2,090
Plat 4, .	381	260	34.61	63.39	90	170	390	27.44	72.56	107	283	1,440
Plat 5, .	488	360	39.20	60.80	141	219	530	27.36	72.64	145	385	1,935
Plat 6, .	542	385	32.21	67.79	124	261	400	25.50	74.50	102	298	1,970
Plat 7, .	526	320	34.40	65.60	110	210	450	24.22	75.78	109	341	1,430
Plat 8, .	359	220	26.82	73.18	59	161	–	–	–	–	–	1,450
Plat 9, .	476	290	34.83	65.17	101	189	425	25.65	74.35	109	316	1,460
Plat 10, .	640	395	35.44	64.56	140	255	425	29.41	70.59	125	300	1,490

Plat 8 has shown, as has been repeatedly pointed out throughout the entire experiment, exceptional conditions, due apparently to injury by insects in the early stage of the growth.

The low yield of Plat 10 in 1892 is evidently due to the use of a lower rate of seed, being the first plat to adjust the seed drill for a definite amount of seed.

An examination of the above tabular statement of the annual yield of the various crops upon the different plate shows that as a rule those plats (4, 7, 9) which had not received in any form nitrogen for manurial purposes yielded much smaller crops than those that received annually in some form or other an addition of available nitrogen. It seemed but proper to sum up in our last annual report our results in the following statement: —

The experiments carried on upon Field A during the years 1889, '90, '91 and '92 show conclusively the importance of a liberal supply to the soil of an available form of nitrogen, to serve a successful and remunerative cultivation of farm crops under otherwise corresponding favorable conditions. For even a leguminous crop, the soja bean, when for the first time raised upon Field A, did not furnish an exception to our observation.

The stated conclusion is in full accord with careful observations of others when raising upon a field for the first time clover or clover-like plants. A deficiency of the soil in regard to the peculiar lower organisms, which in case of clover-like plants are recognized as the medium to assist in the conversion of the atmospheric nitrogen into nitrogenous plant food, is usually considered the cause of the results. This class of crops frequently does better on a second trial upon the same lands.

A liberal introduction of annual leguminous crops into our system of raising field crops is known to improve the nitrogen resources of the farm lands in an economical way.

1893. — The main object of our experiment upon Field A during this season was to observe the after-effect of the cultivation of soja bean (a leguminous crop) on the nitrogen resources of the soil which served for its production. It seemed of interest in our case to ascertain whether the raising of the soja bean upon Field A had increased the amount of available nitrogen stored up in the soil to such an extent as to affect the yield of the succeeding crop upon those plats (4, 7, 9), which as a rule did not receive at any time an addition of available nitrogen from any other manurial source but the atmospheric air and the roots of the soja beans left in the soil after harvesting the crop.

Oats were selected as the crop suitable to serve for that purpose. The general management of the experiment, as far as the preparation of the soil, manuring and seeding-down are concerned, was the same as in preceding years, as will be seen from the subsequent description of the operation.

The field was ploughed Sept. 22, 1892; during the succeeding March the barn-yard manure was applied broadcast to Plat 0, and April 29 the entire field was again ploughed. The remaining plats, 1–10, received their different fertilizer mixtures broadcast on May 4. The entire field was harrowed and pulverized a few days later. The oats were sown May 15, in drills two and a half feet apart, at the rate of three and two-thirds pounds per plat. The seed when tested by germination showed eighty-two per cent. of live seed. The young plants appeared above ground May 22. June 2 and again June 17 all plats were cultivated and hoed.

Height of the Oats upon the Different Plats of Field A during the Season (1893).

[Inches.]

	July 3.	July 10.	July 17.	July 24.	July 31.	August 7.
Plat 0, . . .	20	25	34	44	44	45
Plat 1, . . .	23	30	39	45	46	46
Plat 2, . . .	24	27	39	44	46	46
Plat 3, . . .	20	27	38	44	46	47
Plat 4, . . .	18	20	34	36	40	41
Plat 5, . . .	23	24	36	45	45	46
Plat 6, . . .	20	23	33	40	43	47
Plat 7, . . .	19	23	36	41	44	46
Plat 8, . . .	14	17	29	35	40	46
Plat 9, . . .	19	22	35	38	42	44
Plat 10, . . .	23	31	39	47	48	48

The color of the crop varied on different plats considerably throughout the season. Those receiving no nitrogen appeared

yellowish-green, while those which received nitrogen in the form of dried blood were especially dark-green colored. The crop raised on the plats which received nitrogen in the form of sulphate of ammonia retained the green color somewhat longer than that of the remaining plats.

The crop was cut August 14, 15.

Yield of Oat Crop on Different Plats (1893).

[Pounds.]

	Weight of Oats.	Weight of Oats per Acre.	Weight of Straw and Chaff.	Weight of Grain.	Weight of Straw and Chaff per Acre.	Weight of Grain per Acre.
Plat 0, . . .	530	5,300	399	131	3,990	1,310
Plat 1, . . .	690	6,900	555	135	5,550	1,350
Plat 2, . . .	600	6,000	454	146	4,540	1,460
Plat 3, . . .	700	7,000	534	166	5,340	1,660
Plat 4, . . .	590	5,900	430	160	4,300	1,600
Plat 5, . . .	630	6,300	551	79	5,510	790
Plat 6, . . .	600	6,000	498	102	4,980	1,020
Plat 7, . . .	550	5,500	431	119	4,310	1,190
Plat 8, . . .	420	4,200	325	95	3,250	950
Plat 9, . . .	480	4,800	370	110	3,700	1,100
Plat 10, . . .	610	6,100	485	125	4,850	1,250

Ratio of Grain to Straw.

Plat 0, ...	1:3	Plat 6, ...	1:4.9
Plat 1, ...	1:4.1	Plat 7, ...	1:3.6
Plat 2, ...	1:3.1	Plat 8, ...	1:3.4
Plat 3, ...	1:3.2	Plat 9, ...	1:3.4
Plat 4, ...	1:2.7	Plat 10, ...	1:3.9
Plat 5, ...	1:7		

Conclusions. — An examination of the results given above shows that the total crop on those plats to which no nitrogen was applied (4, 7 and 9) averaged 800 pounds less than in case of the plats which received their regular supply of nitrogen in some form or other.

Plat 8 shows again the exceptional conditions of previous years, for, although fertilized in a like manner as Plat 6, its total yield was 1,800 pounds less.

In yield of grain those plats which received their nitrogen in the form of sulphate of ammonia (5, 6 and 8) averaged 92 pounds; those in the form of organic nitrogen (0, 6 and 8), 140⅔ pounds; those in the form of nitrate of soda (1 and 2), 140½ pounds.

The best results in relation of total yield to yield of grain were obtained in the case of those plats receiving organic nitrogen (dried blood and barn-yard manure), or nitrogen in the form of nitrate of soda; while in the case of sulphate of ammonia the ratio of grain to straw was too wide to give the best satisfaction.

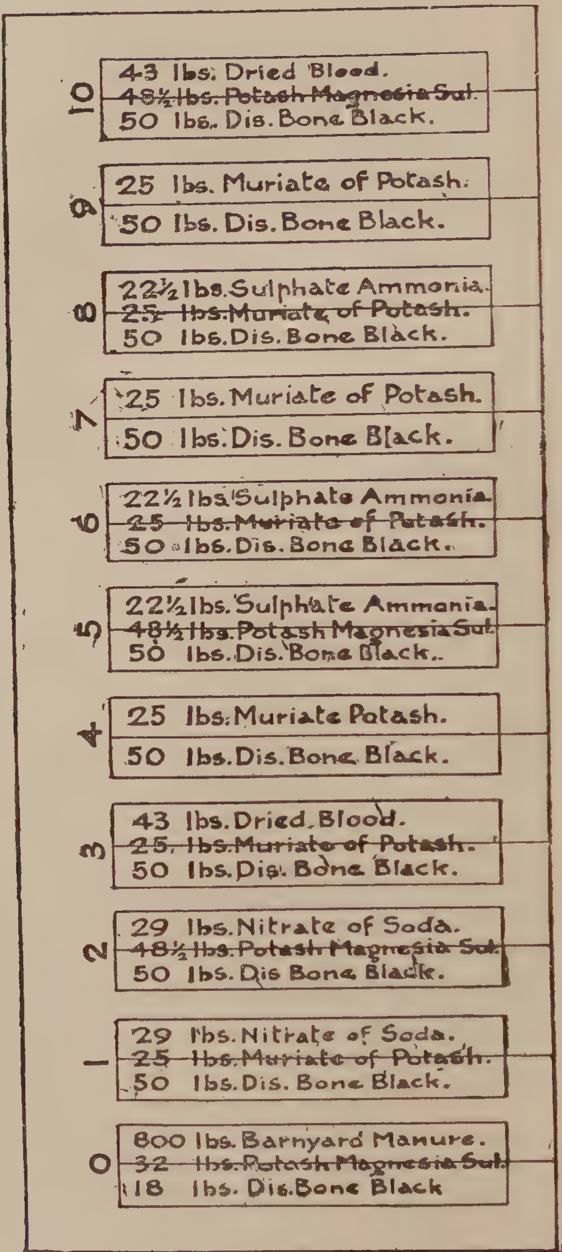
The total yield of crop on the plats receiving no nitrogen addition, as compared with those receiving a nitrogen supply, was: —

With oats in 1890, one-fifth to one-sixth less;
With rye in 1891, one-fifth to one-sixth less;
With soja bean in 1892, one-third to one-fourth less;
With oats in 1893, one-seventh to one-eighth less.

From this it will appear that the introduction of a leguminous crop into our rotation has somewhat reduced the difference in yield between the plats receiving no nitrogen and those receiving it, yet has not entirely obliterated it.

These experiments will be continued another year, with some modifications.

Field "A," 1893.



SCALE, 4 RODS TO 1 INCH.

2. Field Experiments with Several Prominent Varieties of Grasses and of Potatoes.

Field B.

This field occupies an area of one and seven-tenths acres, and runs from north to south, nearly on a level. The soil consists of a somewhat sandy loam of several feet in depth. The systematic treatment of the area was inaugurated in 1884, when the present subdivision into eleven plats was first introduced. The plats are 175 feet long and 33 feet wide (5,775 square feet, or two-fifteenths of an acre), of a uniform shape, running from east to west, with a space of five feet between adjoining plats. The numbering begins at the north end with 11, and closes at the south end with 21. From 1884 to 1889 every alternate plat received annually the same kind and the same amount of fertilizer, — 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre.

From 1889 to the close of the season of 1892 all plats were treated alike, as far as the system of cultivation and of manuring is concerned. The previously stated unmanured plats (12, 14, 16, 18 and 20) received from 1890, like the remaining plats (11, 13, 15, 17, 19 and 21), as manure annually at the rate of 600 pounds of fine-ground bone and 200 pounds of muriate of potash, applied broadcast either as a top dressing or thoroughly ploughed under, as circumstances admitted.

For details regarding the work carried on upon Field B previous to 1892, see tenth annual report.

The character of the crops raised during 1892 may be noticed from the subsequent tabular statement: —

Crops raised in 1892.

Plats.	1892.
Plat 11, .	Kentucky blue-grass, sown Sept. 24, 1889.
Plat 12, .	Kentucky blue-grass and red top, sown Sept. 18, 1891.
Plat 13,	English rye-grass and Italian rye-grass, sown Sept. 29, 1890.
Plat 14, .	English rye-grass and red top, sown Sept. 29, 1890.
Plat 15, .	Herds grass and red top, sown April 23, 1891.
Plat 16, .	Italian rye-grass and red top, sown April 23, 1891
Plat 17, .	Meadow fescue, sown Sept. 25, 1887.
Plat 18, .	Meadow fescue, sown Sept. 29, 1890.
Plat 19, .	Herds grass, sown Sept. 25, 1889.
Plat 20, .	Herds grass and red top, sown Sept. 29, 1890.
Plat 21, .	Meadow fescue and herds grass, sown Sept. 18, 1891.

Area of Each Plat, Two-fifteenths Acre.	Yield of Hay, First and Second Cut (Pounds).	Rate per Acre (Pounds).
Plat 11, sown Sept. 24, 1889, . . .	335	2,513
Plat 12, sown Sept. 18, 1891, . . .	365	2,737
Plat 13, sown Sept. 29, 1890, . . .	255	1,913
Plat 14, sown Sept. 29, 1890, . . .	225	1,688
Plat 15, sown April 23, 1891, . . .	565	4,238
Plat 16, sown April 23, 1891, . . .	565	4,238
Plat 17, sown Sept. 25, 1887, . . .	475	3,563
Plat 18, sown Sept. 29, 1890, . . .	490	3,675
Plat 19, sown Sept. 25, 1889, . . .	610	4,575
Plat 20, sown Sept. 29, 1890, . . .	285	2,138
Plat 21, sown Sept. 18, 1891, . . .	355	2,663
Total, ...	4,525	

At the close of the season (1892) it was decided to raise hereafter other crops than grasses upon plats 11, 13, 14, 15, 16 and 20. For this reason they were ploughed after the rowen had been secured, while plats 12, 17, 18, 19 and 21 remained in grass for another season.

1893. — Plats 11, 13, 14, 15, 16 and 20, which had been used for several preceding years for the production of grasses, were at an early date prepared to serve for experiments with several prominent varieties of potatoes. They were ploughed in August, 1892, and were again ploughed for the final preparation April 25, 1893.

It was proposed to compare the yield, as far as quantity and quality are concerned, under otherwise corresponding circumstances. Three varieties of potatoes, Beauty of Hebron, Clark's, New Queen, were chosen for the trial. The seed potatoes were obtained of J. J. H. Gregory & Son, Marblehead.

Two plats, 15 and 16, were assigned for the cultivation of Beauty of Hebron; two, 13 and 14, for that of New Queen; and two, 11 and 20, for that of Clark's variety.

One plat in each case received its potash supply in form of muriate of potash (plats 11, 13 and 15), and one in each case in that of high-grade sulphate of potash.

The actual amount of potassium oxide used in all cases remained the same.

Statement of Fertilizers used (Pounds).

		Per Plat.	Per Acre.
Plats 11, 13, 15,	Muriate of potash, ...	54	400
	Bone, ...	80	600
Plats 14, 16, 20,	Sulphate of potash (high grade), .	54	400
	Bone, ...	80	600

Composition of Fertilizers used.

	Nitrogen.	Potash.	Phosphoric Acid.
Fine-ground bone, ...	4.02	–	22.96
Sulphate of potash, ...	–	50.20	–
Muriate of potash, ...	–	46.00	–

Market Cost of Fertilizers.

	Per Plat.	Per Acre.
Plats 11, 13, 15, ...	$2 39	$17 93
Plats 14, 16, 20, ...	2 66	19 95

The final mechanical preparation of the different plats was the same in all cases. The fertilizer was applied broadcast, and subsequently thoroughly harrowed in before planting. The potatoes were planted May 10 on all plats at the rate of nineteen bushels per acre, or two and one-half bushels potatoes per plat. Potatoes used were either whole ones of medium size, or when larger were cut in pieces of sizes corresponding to the former. Plats 11 and 20 were planted with Clark's variety; plats 13 and 14 were planted with New Queen variety; plats 15 and 16 were planted with Beauty of Hebron variety.

The crop began to break ground May 26, and was subsequently cultivated and hoed June 5 and June 20. The potatoes were in bloom June 24, and the tops began to die August 14. The crop was harvested August 23 and 24.

The potatoes were in all cases of a superior appearance; only one-eighth to one-ninth of the entire crop was not marketable as a first-class article, on account of small size.

Yield of Crop.

A. Potash applied in the Form of Muriate.

Yield of Potatoes in Pounds.

VARIETY.	Amount per Plat.			Rate per Acre.		
	Marketable.	Small.	Total.	Marketable.	Small.	Total.
Plat 11, Clark's, . .	1,450	225	1,675	10,875	1,688	12,563
Plat 13, New Queen, . .	1,620	240	1,860	12,150	1,800	13,950
Plat 15, Beauty of Hebron,	2,160	190	2,350	16,200	1,425	17,625

Yield of Potatoes in Bushels (60 Pounds per Bushel).

Plat 11, Clark's, . .	–	–	–	181	28	209
Plat 13, New Queen, . .	–	–	–	203	30	233
Plat 15, Beauty of Hebron,	–	–	–	270	24	294

YIELD OF CROP — *Concluded.*

B. Potash applied in the Form of High-grade Sulphate.

Yield of Potatoes in Pounds.

VARIETY.	AMOUNT PER PLAT.			RATE PER ACRE.		
	Marketable.	Small.	Total.	Marketable.	Small.	Total.
Plat 20, Clark's, . .	1,540	230	1,770	11,550	1,725	13,275
Plat 14, New Queen,. .	1,860	190	2,050	13,950	1,425	15,375
Plat 16, Beauty of Hebron,	2,190	240	2,430	16,425	1,800	18,225

Yield of Potatoes in Bushels (60 Pounds per Bushel).

Plat 20, Clark's, . .	–	–	–	193	29	222
Plat 14, New Queen,. .	–	–	–	233	24	257
Plat 16, Beauty of Hebron,	–	–	–	274	30	304

An examination of the above tabular statement of the yield of the different varieties of potatoes on trial reveals the following facts: —

1. The yield of potatoes is in every instance larger in case sulphate of potash has furnished the potash of the fertilizer used, than where muriate of potash has served for that purpose.

2. The yield of the three varieties of potatoes on trial, although raised under a corresponding system of cultivation and of manuring, differs seriously. Beauty of Hebron produces nearly one-sixth more in weight than the New Queen variety, and one-third more than the Clark variety.

Plats 12, 17, 18, 19 and 21, which remained in grass in previous years, received as top-dressing, muriate of potash, 200 pounds, and ground bone, 600 pounds, per acre, at an early date in the spring, 1893. The grass was cut June 27 and 28. As the weeds began to infest the plats, the experiment of studying a variety of grasses was closed, and the sod turned under during the month of August. Dry lands

do not favor for any length of time an economical and clean cultivation of the majority of our best grasses.

Yield of First Cut of Grass, Hay (1893).

Plat 12, Kentucky blue-grass, ... sown Sept. 24, 1889.
Plat 17, Meadow fescue, ... sown Sept. 25, 1887.
Plat 18, Meadow fescue, ... sown Sept. 29, 1890.
Plat 19, Herds grass, ... sown Sept. 25, 1889.
Plat 21, Meadow fescue and herds grass, . . sown Sept. 18, 1891.

	Yield per Plat (Pounds).	Rate per Acre (Pounds).
Plat 12, ...	280	2,100
Plat 17, ...	280	2,100
Plat 18, ...	240	1,800
Plat 19, ...	430	3,225
Plat 21, ...	410	3,075

Value of Grass Fertilizer.

	Per Plat.	Per Acre.
Plats 12, 17, 18, 19, 21, ...	$2 39	$17 93

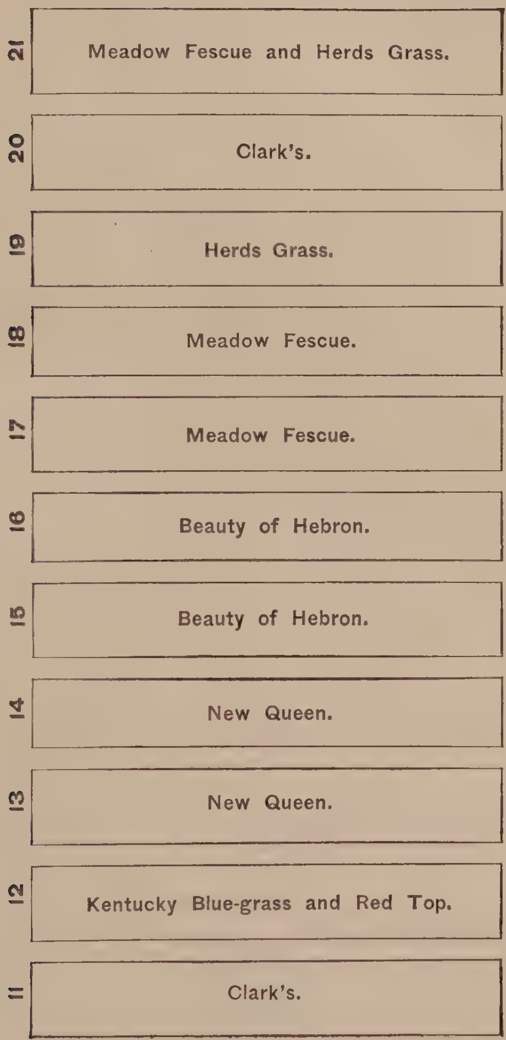
Some of our observations with grasses upon Field B deserve serious consideration of farmers in our section of the country : —

1. Italian rye grass is less liable to be winter-killed with us than English rye grass.

2. Meadow fescue furnishes a valuable grass, as far as a continuation of a healthy growth during a series of years is concerned, and excels in that respect the herds grass.

3. Grass mixtures as a rule yield larger crops than the same varieties when cultivated by themselves.

Field "B," 1893.



Scale, 4 rods to 1 inch.

3. Field Experiments to ascertain the Influence of Different Mixtures of Commercial Fertilizers on the Yield and General Character of Several Prominent Garden Crops.

Field C.

The area devoted to the above-stated experiment is 189 feet long and 164 feet wide; it is subdivided into six plats of uniform size (88 by 62 feet, or about one-eighth of an acre each). The plats are separated from each other and from the adjoining cultivated fields by a space of five feet of unmanured and unseeded yet cultivated land. They are arranged in two parallel rows, running from west to east. Nos. 1, 2 and 3 are along the north side of the field, beginning with No. 1 at its west end, while plats Nos. 4, 5 and 6 are located along its south side, beginning with Plat 4 on the west end. The soil is several feet deep, and consists of a light, somewhat gravelly loam, and was in a fair state of productiveness when assigned for the experiment here under consideration.

The entire field occupied by the experiment is nearly on a level. Its past history (since 1885), as far as mode of cultivation and manuring is concerned, is well known. Ground bone and muriate of potash, 600 pounds of the former and 200 pounds of the latter per acre, have been used for more than six years preceding 1891 as general fertilizer. No stable manure of any description has been applied to the field for seven years preceding. General field crops, as grain crops, leguminous plants, potatoes, etc., have been raised upon the grounds in suitable rotation during that period.

The observation with raising garden crops, by the aid of different mixtures of commercial manurial substances here under special consideration, began upon plats Nos. 4, 5 and 6 during the spring of 1891, and upon plats 1, 2 and 3 during that of 1892. The difference of the fertilizers applied consisted in the circumstance that different forms of nitrogen and potash were used for their preparation. All plats received essentially the same quantity of nitrogen, potash

and phosphoric acid, and every one of them received its phosphoric acid addition in the same form, namely, dissolved bone-black. Some plats received their nitrogen supply in the form of organic animal matter, dried blood; others received their nitrogen in the form of sodium nitrate, Chili saltpetre; others in the form of ammonium sulphate. Some plats received their potash in the form of muriate of potash and others in the form of the highest grade of potassium sulphate (in our market 95 per cent.). The subsequent tabular statement shows the quantities of the manurial substances applied to the different plats: —

PLATS.	Annual Supply of Manurial Substances.	Pounds.
Plat 1,	Sulphate of ammonia,	38
	Muriate of potash,	30
	Dissolved bone-black,	40
Plat 2,	Nitrate of soda,	47
	Muriate of potash,	30
	Dissolved bone-black,	40
Plat 3,	Dried blood,	75
	Muriate of potash,	30
	Dissolved bone-black,	40
Plat 4,	Sulphate of ammonia,	38
	Sulphate of potash,	30
	Dissolved bone-black,	40
Plat 5,	Nitrate of soda,	47
	Sulphate of potash,	30
	Dissolved bone-black,	40
Plat 6,	Dried blood,	75
	Sulphate of potash,	30
	Dissolved bone-black,	40

This proportion corresponds per acre to: —

	Pounds.
Phosphoric acid (available),	50.4
Nitrogen,	60.0
Potassium oxide,	120.0

Beets, cabbages, celery, lettuce, spinach, tomatoes and potatoes have been raised upon the field. One or more of noted varieties of each, as specified in our previous annual reports for 1891 and 1892, have thus far been tried. The field results of 1891 and 1892 have been published without

comment, to enable us to accumulate more facts for the support of our conclusions. Upon a few subsequent pages will be found a description of the management of the experiments during the season of 1893, accompanied by a brief compilation and discussion of all the results thus far obtained.

The entire field was ploughed April 26, and the fertilizer mixtures given in the previous tabular statement were applied broadcast to the plats. The soil was subsequently harrowed and pulverized. All the crops were sown or planted as circumstances advised in rows two and one-half feet apart. Each of the different crops was sown or planted on the same day in all cases. Celery, cabbages, lettuce and tomatoes were raised in hot-beds, and afterwards transplanted to the different plats; while with spinach, beets and potatoes the seed was sown directly upon the plats.

The following order in arranging the different crops was adopted, beginning in each plat at its western end: —

Two rows of spinach, variety New Zealand.
One row of celery, variety Dwarf Golden Heart.
One row of lettuce, variety Hanson.
One row of red cabbage, variety Red Dutch.
Two rows of beets, variety Edmund's Blood Turnip.
Five rows of potatoes, variety Beauty of Hebron.
Two rows of beets, variety Edmund's Blood Turnip.
Three rows of cabbages, variety Fottler's.
Two rows of tomatoes, variety Essex Hybrid.

The order of arrangement of the different crops within each plat was the same in all of them for the same year. They occupied, however, a different position relative to each other in successive years, to introduce, as far as practicable, a system of rotation of crops.

Order of arrangement of crops in plats: —

1892.
Celery.
Lettuce.
Spinach.
Beets.
Cabbages.
Tomatoes.
Potatoes.

1893.
Spinach.
Celery.
Lettuce.
Red Cabbage.
Beets.
Potatoes.
Beets.
White Cabbage.
Tomatoes.

A computation of the results of a chemical analysis of twenty prominent garden crops shows the following average relative proportion of the three above-stated essential ingredients of plant food: —

Nitrogen,	2.2
Potassium oxide,	2.0
Phosphoric acid,	1.0

One thousand pounds of green garden vegetables contain, on the above-stated basis of relative proportion of essential constituents of plant food: —

4.1 pounds of nitrogen.
3.9 pounds of potassium oxide.
1.9 pounds of phosphoric acid.

The weights and particular stage of growth of the vegetables when harvested control under otherwise corresponding conditions the actual consumption of each of these articles of plant food. Our information regarding these points is still too fragmentary to enable a more detailed statement here beyond relative proportions. It must suffice for the present to call attention to the fact that a liberal manuring within reasonable limits pays, as a rule, better than a scanty one.

The various mixtures of fertilizers used by us in the experiments under discussion provide by actual supply for one-half of the available nitrogen actually called for to meet the demand as above pointed out. A liberal cultivation of peas and beans cannot fail to benefit the nitrogen resources of the soil.

Potatoes were planted May 10; spinach and beets were sown May 15; lettuce and cabbage plants were set out May 15; tomatoes were set out May 29; celery plants were set out June 20. The seeds in every case were taken from the same lot; the young plants were raised under corresponding conditions in the same hot-bed, and a corresponding number transplanted in each plat. All plats were kept clean from weeds and treated in a like manner during the season. The crops were harvested whenever fit for the market. The subsequent tabular statements of the yield of the crops show the date of maturity and the quantity obtained at different dates: —

Yield of Spinach (Variety New Zealand).

PLATS.	Pounds.
Plat 1 (two rows),	167½
Plat 2 (two rows),	182
Plat 3 (two rows),	180½
Plat 4 (two rows),	57
Plat 5 (two rows),	210
Plat 6 (two rows),	198½

The seed was sown May 10; the crop was harvested July 12. The low yield of Plat 4 was due to poor germination of the seed.

Yield of Beets (Variety Edmund's Blood Turnip).

Plats.	Pounds.
Plat 1 (four rows),	284½
Plat 2 (four rows),	382
Plat 3 (four rows),	241½
Plat 4 (four rows),	371½
Plat 5 (four rows),	468½
Plat 6 (four rows),	447

The seed was sown May 15, came up May 22, and the roots were harvested October 17.

Yield of Red Cabbage (Variety Red Dutch).

Plats.	Perfect Heads.	Pounds.
Plat 1 (one row; thirty-five plants),	29	266¼
Plat 2 (one row; thirty-five plants),	29	213½
Plat 3 (one row; thirty-five plants),	28	178½
Plat 4 (one row; thirty-five plants),	27	180½
Plat 5 (one row; thirty-five plants),	27	188½
Plat 6 (one row; thirty-five plants),	32	215½

The plants were set out May 15 and harvested October 2.

Yield of White Cabbage (Fottler's).

Plats.	Perfect Heads.	Pounds.
Plat 1 (three rows; thirty-four plants each),	77	605
Plat 2 (three rows; thirty-four plants each),	77	597¼
Plat 3 (three rows; thirty-four plants each),	87	600¾
Plat 4 (three rows; thirty-four plants each),	70	674¾
Plat 5 (three rows; thirty-four plants each),	87	711
Plat 6 (three rows; thirty-four plants each),	86	730¾

The plants were set out May 15; they were harvested September 1 to October 2.

Yield of Potatoes (Variety Beauty of Hebron).

Plats.	Pounds.		
	Marketable.	Small.	Total.
Plat 1 (five rows), ...	314	86	400
Plat 2 (five rows), ...	458	62	520
Plat 3 (five rows), ...	309	81	390
Plat 4 (five rows), ...	455	70	525
Plat 5 (five rows), ...	462	58	520
Plat 6 (five rows), ...	475	105	580

The potatoes were planted May 10, one bushel of seed being used per plat; they were dug August 19.

Yield of Celery (Variety Dwarf Golden Heart).

Plats.	Perfect Heads	Pounds.
Plat 1 (one row; eighty plants), . . .	*	*
Plat 2 (one row; eighty-four plants), . .	*	*
Plat 3 (one row; eighty-four plants), . .	*	*
Plat 4 (one row; eighty-four plants), . .	*	*
Plat 5 (one row; eighty-four plants), . .	*	*
Plat 6 (one row; eighty-four plants), . .	*	*

* Practically a failure on account of the drought.

The plants were set out June 20.

Yield of Lettuce (Variety Hanson).

Plats.	Perfect Heads.	Pounds.
Plat 1 (one row; seventy-five plants), . .	65	37½
Plat 2 (one row; seventy-five plants), . .	67	40
Plat 3 (one row; seventy-three plants), . .	68	45
Plat 4 (one row; seventy-seven plants), . .	71	62½
Plat 5 (one row; seventy-five plants), . .	73	75
Plat 6 (one row; seventy-five plants), . .	67	52

The plants were set out May 15; they were harvested July 6.

Yield of Tomatoes (Variety Essex Hybrid).

Date of Harvesting.	Plats. 1.	2.	3.	4.	5.	6.
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
August 8 (matured); . .	22	20	15½	12¼	9	15½
August 11 (matured), . .	25	18½	24½	24½	26½	18
August 16 (matured), . .	38	35	48	55¼	52	49
August 21 (matured), . .	36½	42½	25¼	49	48¼	63
August 25 (matured), . .	32½	46½	47	53	53½	65½
August 30 (matured), . .	45	80	73	72	100¾	57
September 1 (matured), .	16½	65½	61	86½	85½	32¾
September 5 (matured), .	19	47	77	95	112	60¼
September 11 (matured), .	26	83	89	62½	122½	39
September 15 (matured), .	19½	111	86½	71	92	19½
September 20 (matured), .	26½	111½	93¼	100½	154¾	35
Total weight of matured tomatoes, . . .	306½	660½	640	681½	756¼	437½
September 23 (green), . .	56½	214	167¼	137	222½	81
Total weight of tomatoes, both matured and green,	363	874½	807¼	818½	978¾	515½

There were two rows in each plat, and from twenty-two to twenty-three plants in each row. The plants were set out from the hot-bed May 29; they came in bloom June 16, and began to form tomatoes June 29.

Potatoes (Variety Beauty of Hebron).

Plats.	Pounds. 1891.	1892.	1893.
Plat 1 (five rows), ...	–	585	400
Plat 2 (five rows), ...	–	665	520
Plat 3 (five rows), ...	–	545	390
Plat 4 (five rows), ...	735	640	525
Plat 5 (five rows), ...	780	740	520
Plat 6 (five rows), ...	–	435	580

Tomatoes (Variety Essex Hybrid).

Plats	Pounds.		
	1891.	1892.	1893.
Plat 1 (two rows), ...	–	464	339
Plat 2 (two rows), ...	–	572	874½
Plat 3 (two rows), ...	–	466	807
Plat 4 (two rows), ...	641	515	783
Plat 5 (two rows), ...	647	593	928½
Plat 6 (two rows), ...	–	332	515

Lettuce (Variety Hanson).

Seventy Plants.	1892.	1893.
Plat 1 (one row), ...	41½	40½
Plat 2 (one row), ...	36	42
Plat 3 (one row), ...	43	46
Plat 4 (one row), ...	76	62
Plat 5 (one row), ...	60	70
Plat 6 (one row), ...	36	55

Cabbages (Variety Fottler's).

Sixty-two Plants.	1892.	1893.
Plat 1 (two rows), ...	534	490
Plat 2 (two rows), ...	762	484
Plat 3 (two rows), ...	576	428
Plat 4 (two rows), ...	458	595
Plat 5 (two rows), ...	674	508
Plat 6 (two rows), ...	586	527

Spinach (Variety New Zealand).

Plats.	1892.	1893.
Plat 1 (two rows),	192	167½
Plat 2 (two rows),	233	182
Plat 3 (two rows),	202	180½
Plat 4 (two rows),	230	–
Plat 5 (two rows),	232	210
Plat 6 (two rows),	134	198½

Beets (Variety Edmund's Blood Turnip).

Plats.	1892.	1893.
Plat 1 (four rows),	350	284½
Plat 2 (four rows),	345	382
Plat 3 (four rows),	515	241½
Plat 4 (four rows),	455	371½
Plat 5 (four rows),	509	468½
Plat 6 (four rows),	495	447

An examination of the preceding results shows the serious influence of the dry weather throughout a large part of the past season, as affecting the total yield of the different plats as compared with each other. Potatoes, cabbages, beets and spinach show a marked decrease in total yield over last year, while lettuce and tomatoes show a considerably larger yield. The relative yield of the plats for both seasons is only slightly affected.

Field C, Eastern Portion.

The portion of Field C east of the plats is 183 by 131 feet, and contains .55 acre. The fertilizer applied consisted of 300 pounds of fine-ground bone and 100 pounds

of muriate of potash, applied broadcast. On May 8 the field was sown to vetch and oats, 25 pounds of vetch and 2½ bushels of oats being used for seed. The crop made an even and rapid growth. About two-fifths of the crop was used for green fodder July 6 to 18. The remainder was cut as hay. The area cut for green fodder yielded 5,053 pounds, or 21,800 pounds per acre; that cut as hay weighed 1,750 pounds, or 5,469 pounds per acre. On July 28 the land was again ploughed. A fertilizer mixture, composed of 100 pounds of nitrate of potash and 300 pounds of ground bone, was applied broadcast and harrowed in. August 4 the field was sown to buckwheat; this came in bloom September 1. The crop began to be cut for green fodder when in full bloom, September 11, and the cutting was completed September 29. The yield of green fodder was 3,870 pounds, or 7,036 pounds of green fodder per acre.

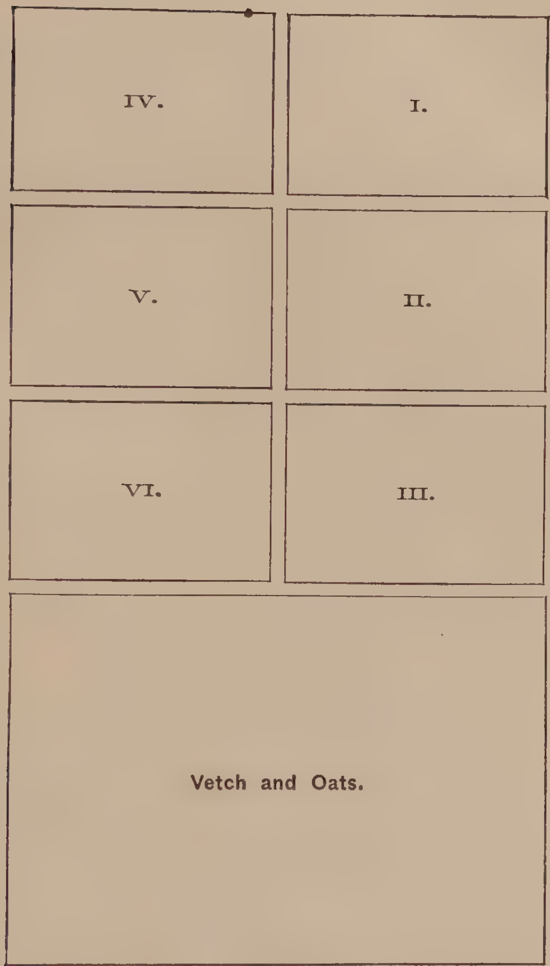
Analysis of Vetch and Oats (Green).

Moisture at 100° C.,	79.16
Dry matter,	20.84
	100.00

Analysis of Dry Matter.

Crude ash,	8.80
" cellulose,	30.34
" fat,	3.90
" protein,	13.27
Nitrogen-free extract matter,	43.69
	100.00

Field "C," 1893.



Scale, 4 rods to 1 inch.

4. Experiments with a Variety of New Forage Crops (1893).

Field D.

This field has been used for the past two years for the raising of a variety of reputed annual and perennial fodder crops, in the majority of cases new to our section of the country, to study their adaptation to our climate and soil. Some of them have since been raised on a larger scale successfully and profitably for the support of our dairy stock.

The field is 328 feet long and 70 feet wide, covering an area of 22,960 square feet, or .527 acre. The land was ploughed April 24 and May 10. The fertilizer used consisted of a mixture of 600 pounds of ground bone and 200 pounds of muriate of potash, which was applied broadcast and harrowed in before seeding. The different crops were planted in rows two and one-half feet apart, and were kept free from weeds throughout the season. They were arranged in the field during the past season in the following order, beginning at the west end: —

White lupine (*Lupinus albus*).
Yellow lupine (*Lupinus lutens*).
Prickley comfrey (*Symphytum officinale*).
Forest pea or flat pea (*Lathyrus sylvestris*).
Late-maturing soja bean (*Soja hispida*).
Kidney vetch (*Anthyllis vulneraria*).
Early-maturing white soja bean (*Soja hispida*).
Sainfoin (*Onobrychis sativa*).
Early-maturing black soja bean (*Soja hispida*).
Cow-pea (*Dolichos sinensis*).
Serradella (*Ornithopus sativus*).
Spring vetch (*Vicia sativa*).
Bokhara clover (*Melilotus alba*).
Horse bean (*Vicia faba*).
Kaffir corn.
Common buckwheat (*Fagopyrum esculentum*).
Japanese buckwheat (*Fagopyrum esculentum*).
Silver-hull buckwheat (*Fagopyrum esculentum*).
Summer rape (*Brassica Napus*).
Carrots (*Daucus carota*).

White lupine (*Lupinus alba*), four rows. The seed was sown May 19. The young plants broke ground May 29;

they were considerably affected by the drought of July and August. The plants proved to be of a late variety, blossoming the latter part of September. The seed was bought of J. M. Thorburn, New York City, at eleven cents per pound.

Yellow lupine (*Lupinus lutens*), four rows. The seed was sown May 19 and came up May 29. The plants began to blossom July 29, pods commenced forming August 5, and ripened seed throughout the month of September. Large, well-formed tubercles were found on the roots of this, as well as on those of the preceding variety.

Both varieties of lupine deserve a high recommendation for green manuring, having served us well for that purpose.

Prickley comfrey (*Symphytum officinale*), one row. The roots remained in the ground from last year, and wintered well during the winter of 1892–93. The plants started into growth early in the spring, and blossomed June 13; July 24 they were cut. The plants were again cut early in the fall. Both cuttings showed a liberal, vigorous growth. This fodder plant offers but little inducement for home cultivation when compared with many of our annual leguminous plants.

Forest pea or flat pea (*Lathyrus sylvestris*), three rows. The roots remained in the ground from last year; they were partially winter-killed. The crop blossomed June 24 and was cut July 27, at which time the growth was large and rank. A second growth was cut during the fall. Our results thus far are but little encouraging.

Late-maturing soja bean (*Soja hispida*), two rows. The seed was sown May 19, the young plants appearing above the ground May 29. They made a vigorous and leafy growth, blossoming September 15. This variety is apparently of much less feeding value than the earlier blooming varieties. The seed was obtained of J. M. Thorburn of New York City, at eight cents per pound.

Kidney vetch (*Anthyllis vulneraria*), four rows. The roots remained in the ground from last year, and wintered very well. The plants blossomed for the first time since seeding June 13; they were cut July 24. No second cut was obtained. It is a very attractive plant when in bloom. Seed was bought of D. Landreth & Sons, Philadelphia, Pa.

Early-maturing white soja bean (*Soja hispida*), ten rows.

The seed was sown May 19 and came up May 29. The plants began to blossom July 17; they were cut August 19. The seed was of our own raising. This variety has served us well for several years as hay and as ensilage (see previous reports).

Sainfoin (*Onobrychis sativa*), five rows. The crop wintered well from last year. The plants began to blossom June 5 and were cut July 27. A second growth was produced. The seed was bought of Henry Nungesser, New York City, at six cents per pound.

Early-maturing black soja bean (*Soja hispida*), five rows. The seed was sown May 19 and the young plants broke ground May 29. They came into bloom July 17 and were cut August 19. The only marked difference between the black and the white varieties consists in the color of the seeds and of more foliaceous growth in the case of the black variety. It is a valuable fodder plant and stands our climate well. The seed used was of our own raising.

Cow-pea (*Dolichos sinensis*), five rows. The seed was sown May 19, the young plants appearing above ground May 26. August 26 the plants blossomed and were cut for fodder. Most varieties of this plant do not produce ripe seed with us. The seed was obtained of D. Landreth & Sons, Philadelphia, Pa.

Serradella (*Ornithopus sativus*), five rows. The seed was sown May 19 and came up May 29; blossoms appeared July 11 and the crop was cut for fodder August 14. The growth was very rank and heavy. The crop has supplied us for years with a good green fodder. The seed was obtained of Henry Nungesser, New York City, at eight cents per pound.

Spring vetch (*Vicia sativa*), five rows. The seed was sown May 19, the plants appearing May 26 and beginning to blossom July 11. August 4 the growth was cut for fodder. Vetch with oats has furnished us for several years an excellent material for green fodder and hay. The seed was obtained of Henry Nungesser, New York City, at eight cents per pound.

Bokhara clover (*Melilotus alba*), five rows. The seed was sown May 19. The plants appeared above ground May 26, and were cut August 12, at which time there were no signs of blooming. There was a small second growth. The plant with us is apt to grow rank and too woody to furnish an

acceptable fodder article for any length of time. The seed was bought of Henry Nungesser, New York City, at twenty cents per pound.

Horse bean (*Vicia faba*), five rows. The seed was sown May 19 and came up May 29. The plants began to bloom July 11. During the summer a blight attacked some of the leaves, turning them black. The plant furnishes a good green fodder when raised in connection with oats or barley and vetch. The seeds are very nutritious. The plants were cut September 28. The seed was obtained of J. M. Thorburn & Sons, New York, N. Y., at nine cents per pound.

Kaffir corn, one row. The seed was sent on for trial from Lawrence, Kan. It was planted May 19 and began to come up May 30; August 26 the plants began to head out. They reached a height of five feet, and were characterized by slender but very leafy stems. No great agricultural merit could be obtained in our section of the country, as the plant does not mature.

Common buckwheat (*Fagopyrum esculentum*), five rows. The seed was sown May 19. The plants broke ground May 27 and came in bloom June 24. This buckwheat made a smaller growth than either of the others. It was cut for fodder July 31. We have used common buckwheat with good results as second crop after vetch and oats or summer grain, to serve as green fodder for cattle during the latter part of the season.

Japanese buckwheat (*Fagopyrum esculentum*), five rows. The seed was sown May 19 and came up May 25. The plants came in blossom June 24. The growth was very heavy, the leaf development being greater than in the case of either of the two other varieties of buckwheat. The plants were cut for fodder, when beginning to form seed, on August 2. This variety deserves the serious attention of farmers as a substitute for our common buckwheat. The seed was obtained of J. M. Thorburn, New York, N. Y., at six cents per pound.

Silver-hull buckwheat (*Fagopyrum esculentum*), five rows. The seed was sown May 19. The plants broke ground May 27 and came into bloom June 24. July 29 they were cut for fodder. The seed was obtained of J. M. Thorburn, New York City, at six and one-fourth cents per pound.

Summer rape (*Brassica Napus*), five rows. The seed was sown May 19 and came up May 25. The plants were cut for fodder August 7, at which date they showed no signs of blooming. A second growth was cut early in the fall. Both cuttings showed a healthy and abundant growth. The seed was obtained of D. Landreth & Sons, Philadelphia, Pa.

Carrots (*Daucus carota*). The seed was sown June 1, appearing above ground June 10. The plat (.155 acres) was weeded and hoed July 10. The crop was harvested November 2. Yield, 5,540 pounds, or 13–14 tons per acre.

Analyses of Crops raised upon Field D (1893).

[I., common buckwheat (*Fagopyrum esculentum*): dried; cut when in bloom. II, silver-hull buckwheat (*Fagopyrum esculentum*): dried; in bloom. III., Japanese buckwheat (*Fagopyrum esculentum*): dried; in bloom. IV., summer rape (*Brassica Napus*): dried; cut before blooming. V., prickley comfrey (*Symphytum officinale*): second growth.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	8.50	8.91	5.71	11.13	86.79
Dry matter,	91.50	91.09	94.29	88.87	13.21
	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.					
Crude ash,	14.63	10.17	12.36	18.25	21.12
" cellulose,	19.35	27.07	36.02	18.15	11.03
" fat,	3.04	2.55	2.22	3.79	2.06
" protein,	17.90	12.22	10.80	14.43	17.49
Nitrogen-free extract matter,	45.08	47.99	38.60	45.38	48.00
	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

	I.	II.	III.	IV.	V.
Moisture at 100° C.,	8.500	8.910	5.720	11.130	86.790
Dry matter contains: —					
Nitrogen,	2.866	1.954	1.727	2.310	2.800
Potassium oxide,	3.504	2.612	3.521	5.254	5.745
Calcium oxide,	–*	2.514	3.625	4.153	2.263
Magnesium oxide,	–*	.577	.446	.587	.310
Phosphoric acid,	.547	.944	.903	.643	.870
Insoluble matter,	–*	.507	.400	.781	–*

* Not determined.

Analyses of Crops raised upon Field D (1893) — Continued.

[I., yellow lupine (*Lupinus lutens*) : in bloom. II., white lupine (*Lupinus albus*) : in bloom. III., sainfoin (*Onobrychis sativus*) : dried ; in bloom. IV., Bokhara clover (*Melilotus alba*) : dried ; in bloom. V., serradella (*Ornithopus sativa*) : green ; in bloom. VI., kidney vetch (*Anthyllis vulneraria*) : second growth ; in bloom.]

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C., .	86.05	85.35	12.17	7.43	82.41	80.85
Dry matter, . .	13.95	14.65	87.83	92.57	17.59	19.15
	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.						
Crude ash, . . .	11.14	5.03	8.54	7.66	10.99	13.28
" cellulose, .	27.10	31.18	26.95	30.57	30.08	14.94
" fat, . . .	1.87	2.41	4.49	3.32	2.41	3.51
" protein, . .	17.84	18.71	17.70	13.37	15.01	18.43
Nitrogen-free extract matter, . . .	42.05	42.67	42.27	45.08	41.13	49.84
	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

Moisture at 100° C., .	85.05	85.350	12.170	7.430	82.410	80.850
Dry matter contains : —						
Nitrogen, . .	2.662	2.993	2.880	2.133	2.632	2.939
Potassium oxide, .	2.949	1.730	2.299	1.979	2.414	1.754
Calcium oxide, .	1.926	3.070	1.320	1.927	2.636	4.736
Magnesium oxide,	.328	.730	.489	.374	.384	.287
Phosphoric acid, .	.603	.350	.854	.602	.804	.443
Insoluble matter, .	1.076	.900	.535	.061	.557	.809

Analyses of Crops raised upon Field D (1893) — Concluded.

[I., flat pea (*Lathyrus sylvestris*): in bloom. II., flat pea (*Lathyrus sylvestris*): second growth. III., common vetch (*Vicia sativa*): in bloom. IV., horse bean (*Vicia faba*): with pods forming. V., soja bean (*Soja hispida*): with pods forming. VI., cow-pea (*Dolichos sinensis*): with pods forming.

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C., .	8.96	78.62	9.90	84.83	76.42	80.31
Dry matter, . .	91.10	21.38	91.10	15.17	23.58	19.69
	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.						
Crude ash, . . .	9.39	8.91	8.24	5.75	7.74	9.29
" cellulose, .	31.76	20.38	30.27	28.17	26.47	21.67
" fat, . . .	1.78	5.00	2.50	2.31	4.84	4.06
" protein, . .	24.04	30.65	15.09	16.68	16.45	17.05
Nitrogen-free extract matter, . . .	33.03	35.06	43.80	47.09	44.50	47.93
	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

Moisture at 100° C., .	8.96	78.62	9.90	84.83	76.42	80.31
Dry matter contains: —						
Nitrogen, . .	3.846	4.904	2.414	.675	2.476	1.796
Potassium oxide, .	2.572	2.100	3.010	1.370	1.151	1.042
Calcium oxide, .	1.791	1.412	1.860	1.370	2.945	2.964
Magnesium oxide,	.498	.411	–*	.620	1.257	.756
Phosphoric acid, .	.900	.655	.810	.330	.711	.579
Insoluble matter, .	2.011	1.155	.560	2.040	–*	.914

* Not determined.

SPRING VETCH (*Vicia sativa*).

July, 1891. Pods forming.

EARLY-MATURING SOJA BEAN (*Soja hispida*).
September, 1893. With pods formed.

Flat Pea (*Lathyrus sylvestris*).

August, 1893. In bloom.

KIDNEY VETCH (*Anthyllis vulneraria*).

August, 1893. In bloom.

Field "D." — Arrangement of Crops raised.

1892.

W

- Artichoke.
- Prickley Comfrey.
- Pyrethrum.
- Forest Pea.
- Stachy's Tubers.
- Kidney Vetch.
- Winter Rape.
- Sainfoin.
- Yellow Trefoil.
- Spring Vetch.
- Bokhara Clover.
- Summer Rape.
- Horse Bean.
- Serradella.
- Soja Bean.
- Cow-pea.
- Jackson Wonder Bean.
- Blue Lupine.
- White Lupine.
- Yellow Lupine.
- Silver-hull Buckwheat.
- Japanese Buckwheat.
- Common Buckwheat.

E

1893.

- Minnesota Corn.
- White Lupine.
- Yellow Lupine.
- Prickley Comfrey.
- Pyrethrum.
- Forest Pea.
- Late Soja Bean.
- Kidney Vetch.
- Early White Soja Bean.
- Sainfoin.
- Early Black Soja Bean.
- Cow-pea.
- Serradella.
- Spring Vetch.
- Bokhara Clover.
- Horse Bean.
- Kaffir Corn.
- Common Buckwheat.
- Japanese Buckwheat.
- Silver-hull Buckwheat.
- Summer Rape.
- Carrots.

Scale, 50 feet to 1 inch.

Scale, 4 rods to 1 inch.

Field E (Rye).

This field is 260 feet long and 48 feet wide, containing .286 acre. In September of 1892 the field was ploughed and the following fertilizer mixture applied: 200 pounds of fine-ground bone and 70 pounds of high-grade sulphate of potash. The field was then sown to rye and winter rape, two-thirds of a bushel of rye and ten pounds of rape being used for seed. Both the rye and the rape came up and made a fair fall growth. The rye wintered well, but the rape entirely winter-killed.* The rye headed out May 29 and was cut July 12.

Yield of Rye.

	Pounds.
Grain,	336
Straw and chaff,	1,243

Rate per Acre.

Grain,	1,175
Straw and chaff,	4,246

* Judging from the experiment, the seed sown proved to be summer rape instead of winter rape, as supposed.

5. Field Experiments with Different Commercial Phosphates to study the Economy of using the Cheaper Natural Phosphates or the More Costly Acidulated Phosphates.

Field F.

The field selected for this purpose is 300 feet long and 137 feet wide, running on a level from east to west. Previous to 1887 it was used as a meadow, which was well worn out at that time, yielding but a scanty crop of English hay. During the autumn of 1887 the sod was turned under and left in that state over winter. It was decided to prepare the field for special experiments with phosphoric acid by a systematic exhaustion of its inherent resources of plant food. For this reason no manurial matter of any description was applied during the years 1887, 1888 and 1889.

The soil, a fair sandy loam, was carefully prepared every year by ploughing during the fall and in the spring, to improve its mechanical condition to the full extent of existing circumstances. During the same period a crop was raised every year. These crops were selected, as far as practicable, with a view to exhaust the supply of phosphoric acid in particular. Corn, Hungarian grass and leguminous crops (cow-pea, vetch and serradella) followed each other in the order stated.

1890. — The field was subdivided into five plats, running from east to west, each twenty-one feet wide, with a space of eight feet between adjoining plats.

The manurial material applied to each of these five plats contained, in every instance, the same form and the same quantity of potassium oxide and of nitrogen, while the phosphoric acid was furnished in each case in the form of a different commercial phosphoric-acid-containing article, namely, phosphatic slag, Mona guanó, Florida phosphate, South Carolina phosphate (floats) and dissolved bone-black. The market cost of each of these articles controlled the quantity applied, for each plat received the same money value in its particular kind of phosphate.

Cost per Ton.

Phosphatic slag,	$15 00
Mona guano (West Indies),	15 00
Florida rock phosphate,	15 00
South Carolina phosphate (floats),	15 00
Dissolved bone-black,	25 00

Analyses of Phosphates used.

[I., phosphatic slag; II., Mona guano; III., Florida phosphate; IV., South Carolina phosphate; V., dissolved bone-black.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture,	0.47	12.52	2.53	0.39	15.96
Ash,	–	75.99	89.52	–	61.46
Calcium oxide,	46.47	37.49	17.89	46.76	–
Magnesium oxide,	5.05	–	–	–	–
Ferric and aluminic oxides,	14.35	–	14.25	5.78	–
Total phosphoric acid,	19.04	21.88	21.72	27.57	15.82
Soluble phosphoric acid,	–	–	–	–	12.65
Reverted phosphoric acid,	–	7.55	–	4.27	2.52
Insoluble phosphoric acid,	–	14.33	–	23.30	0.65
Insoluble matter,	4.39	2.45	30.50	9.04	6.26

The following fertilizer mixtures have been applied annually to all the plats, with the exception of Plat 3, which received in 1890 ground apatite and in 1891 no phosphate whatever: —

Plats.	Annual Supply of Manurial Substances.	Pounds.
Plat 1 (south, 6,494 square feet),	Ground phosphatic slag,	127
	Nitrate of soda,	43
	Potash-magnesia sulphate,	58
Plat 2 (6,565 square feet),	Ground Mona guano,	128
	Nitrate of soda,	43½
	Potash-magnesia sulphate,	59
Plat 3 (6,636 square feet),	Ground Florida phosphate,	129
	Nitrate of soda,	44
	Potash-magnesia sulphate,	59
Plat 4 (6,707 square feet),	South Carolina phosphate,	131
	Nitrate of soda,	44½
	Potash-magnesia sulphate,	60
Plat 5 (6,778 square feet),	Dissolved bone-black,	78
	Nitrate of soda,	45
	Potash-magnesia sulphate,	61

The phosphatic slag, Mona guano, South Carolina phosphate and Florida phosphate were applied at the rate of 850 pounds per acre; dissolved bone-black at the rate of 500 pounds per acre. Nitrate of soda was applied at the rate of 250 pounds per acre and potash-magnesia sulphate at the rate of 390 pounds per acre.

Potatoes were raised upon the plats in 1890; in 1891 winter wheat was employed (for details see ninth annual report); in 1892 serradella was the crop experimented with (see tenth annual report).

1893. — The field was ploughed April 29. May 6 the fertilizers were applied broadcast to the various plats, and the land was afterwards thoroughly harrowed and pulverized. May 20 corn, variety "Pride of the North," was planted in hills, eighteen quarts being used. The crop was cultivated three times, and hoed twice during the months of June and July. The corn came in bloom August 1 and was cut September 8. It remained in the field until October 10–13, when the ears of corn were picked. During the entire season Plat 1 appeared to make a larger and more rapid growth than any of the other plats.

Height of Plants during the Season.

PLATS.	July 3.	July 10.	July 17.	July 24.	July 31.	Aug. 7.
Plat 0 (inches), . .	10	12	16	23	25	39
Plat 1 (inches), . .	20	32	44	54	73	86
Plat 2 (inches), . .	13	20	26	40	63	80
Plat 3 (inches), . .	10	14	19	31	46	69
Plat 4 (inches), . .	11	15	23	41	57	79
Plat 5 (inches), . .	13	17	27	45	55	81

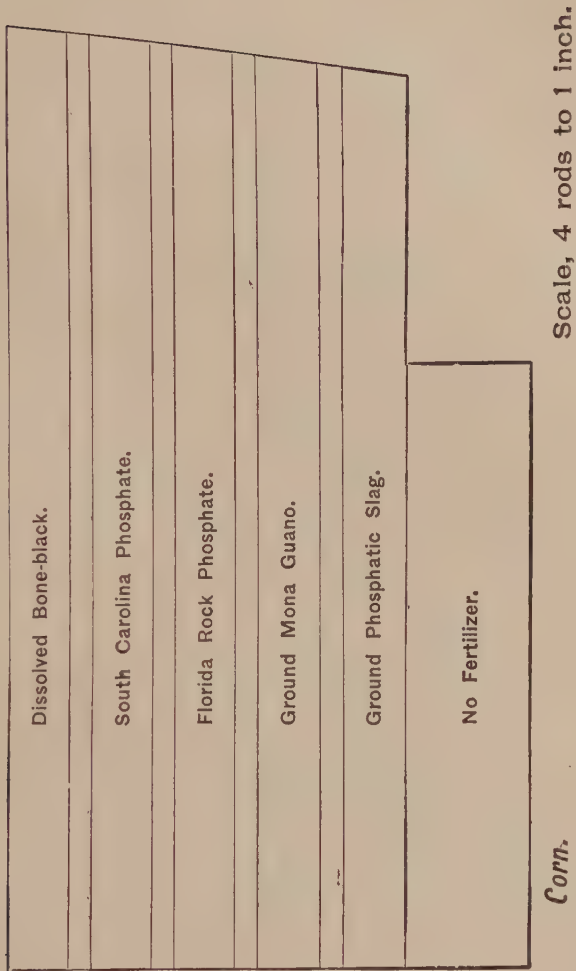
Yield of Crop.

Plats.	Amount per Plat.			Rate per Acre.		
	Ears.	Stover.	Total.	Ears.	Stover.	Total.
Plat 0, . . .	–	650	650	–	3,660	3,660
Plat 1, . . .	470¼	1,190	1,660¼	3,195	7,985	11,180
Plat 2, . . .	571	810	1,381	3,791	5,378	9,169
Plat 3, . . .	432	915	1,347	2,834	6,002	8,836
Plat 4, . . .	579½	890	1,469½	3,767	5,785	9,552
Plat 5, . . .	542¼	780	1,322¼	3,486	5,015	8,501

Relative Ratio of Ears to Stover.

Plat 1, ... 1:2.5
Plat 2, ... 1:1.4
Plat 3, ... 1:2.1
Plat 4, ... 1:1.5
Plat 5, ... 1:1.4

Field "F," 1893.


Dissolved Bone-black.
South Carolina Phosphate.
Florida Rock Phosphate.
Ground Mona Guano.
Ground Phosphatic Slag.
No Fertilizer.
Corn.
Scale, 4 rods to 1 inch.

Field "G," 1893.

Scale, 6 rods to 1 inch.

6. Experiments with Corn.

Field G.

This field is 700 feet long and 75 feet wide; area, 52,500 square feet, or $1\frac{1}{5}$ acres. The land is nearly level and the soil a loam several feet in depth.

May 1 barn-yard manure was applied to the field at the rate of ten tons per acre. A few days later the field was ploughed, harrowed and prepared for planting. The southern end of the field for a distance of fifty feet was planted to artichokes. The remainder of the field was planted to corn, variety "Pride of the North." The corn was planted in hills May 20, sixteen quarts of seed being used. The crop was cultivated June 5 and June 23. August 1 the stalks began to bloom. The crop was cut September 9. Owing to the wet condition of the soil on a portion of the field, the corn on that portion (108 feet of the length of the field) was used for green fodder. The remainder of the crop (.92 acre) stood in the field until October 20, when it was husked.

Yield of Crop (per Acre).

	Pounds.
Ears,	2,920
Stover,	5,917
Total,	8,837

The artichokes were planted May 20 and cultivated throughout the season with the corn. They blossomed late in September. The roots will remain in the ground over winter and are to be dug in the spring.

7. Field Experiments to compare the Effect of Home-made Mixed Stable Manure, of Unleached Wood Ashes and of Various Mixtures of Commercial Fertilizing Materials on the Yield of Some Prominent Farm Crops, when applied as Manure under Otherwise Fairly Corresponding Conditions (1888–94).

East Field.

The land used for these observations covers an area of from seven to eight acres, and is located along the east side of the farm of the station. On its western termination it borders on a meadow in fair condition, and on its eastern side it is separated from a natural thrifty grove by a private road from thirty-five to forty feet wide.

The soil consists of a somewhat sandy loam, with indications of light springs in various parts of the field. The more prominent springs are connected by drain pipes with the main drain of the adjoining meadow since the experiment began.

The entire field slopes gently and quite uniformly from east to west. Corn and grasses represent in the main the crops raised upon the ground in years preceding 1887.

The inferior yield and character of the crops of later years raised upon the land pointed towards an indifferent management, as far as the selection of crops and of manure is concerned. To destroy weeds and other objectionable local growths, it became advisable to introduce a thorough system of drill cultivation.

In the autumn of 1887 the sod which covered the entire area was turned under by ploughing, and subsequently, by a repeated use of a wheel harrow, was thoroughly broken up. One ton of unleached wood ashes (per acre), applied broadcast and slightly ploughed in before the close of the season, served as manure for the coming year (1888).

The succeeding spring, after a thorough mechanical preparation of the soil by ploughing and harrowing, the following crops were planted: potatoes, barley, oats and corn.

They were sown in rows running along the sloping grounds from north to south, to secure favorable conditions for an advantageous and liberal use of a horse cultivator in the interest of clean cultivation.

The crops raised during that season showed a fairly uniform state of productiveness of the entire field here under discussion.

1889. — The field experiments with different manures, which are the special subject of this chapter, began during the spring of that year.

The lands previously described are divided by a grass road into two parts, a north and a south field. The former occupies a space of from five to six acres and the latter three to four acres. Each of these fields, running from north to south, was subsequently subdivided into five plats, which were kept separate from each other by a space of land fourteen feet wide, running along the entire length of each plat from east to west. The spaces between adjoining plats were cultivated and planted in connection with the main plats. They received, however, at no time manure of any description during the entire experiment.

The crops selected for the experiment were in all cases planted in the same manner across the five plats set apart for the observation. They occupied in every case, as far as the same crops are concerned, the same area. The mechanical preparation of the soil was alike in case of the same crop; the same statement applies to the special treatment, as cultivating, etc., during the growing season, and to the mode of harvesting.

The difference in the treatment of the five plats was entirely confined to a different mode of supplying plant food to the crops raised; each plat was treated year after year in the following manner (1889 to 1894): —

Fertilizer applied Each Year from 1889 to 1894.

Plat I. — Home-made mixed barn-yard manure, 18,000 pounds (rate of 10 tons per acre).

Plat II. — Wood ashes, 1,800 pounds (rate of 1 ton per acre).

Plat III. — No fertilizer.

Plat IV. — Ground bone, 540 pounds (rate of 600 pounds per acre); muriate of potash, 180 pounds (rate of 200 pounds per acre).

Plat V. — Ground bone, 540 pounds (rate of 600 pounds per acre); sulphate of potash and magnesia, 360 pounds (rate of 400 pounds per acre).

Composition of Fertilizers used.

	Per Cent.		
	Nitrogen.	Phosphoric Acid.	Potassium Oxide.
Barn-yard manure,	.568	.688	.523
Wood ashes,	–	1.45	7.63
Muriate of potash,	–	–	46.00
Sulphate of potash and magnesia,	–	–	24.32
Fine-ground bone,	4.02	22.96	–

The basis of the valuation of the essential fertilizing ingredients contained in barn-yard manure is the same as adopted in case of feed stuffs, viz.: —

	Cents per Pound.
Nitrogen,	$17\frac{1}{2}$
Phosphoric acid,	5
Potassium oxide,	$5\frac{1}{2}$

Market Cost at Amherst of Fertilizers used.

	Cost per Plat.	Cost per Acre.
Plat I.,	$29 34	$32 60
Plat II.,	9 90	11 00
Plat IV.	11 16	12 40
Plat V.,	14 83	16 48

The barn-yard manure was applied broadcast in the fall and ploughed in early in the spring. The wood ashes and commercial fertilizers were applied broadcast and harrowed

in before seeding down. The amount of barn-yard manure (plat I.) used is an exceptional one, for the purpose of securing its highest effect. The annual amount of the remaining fertilizers in case of plats II., IV. and V. is within customary farm practice.

Name of Crop raised (1889).	Entire Area occupied by the Crop.	Area occupied by the Crop in Each Plat.
	Acres.	Acres.
Barley (in drills two feet apart), ...	.88	.158
Barley (broadcast), ...	.81	.146
Dent corn, "Pride of the North" (rows three feet three inches apart), ...	3.31	.596

Amount of Seed used per Acre.

	Pounds.
Barley, in drills, ...	57
Barley, broadcast, ...	70
Dent corn, "Pride of the North" (rows three feet three inches apart), ...	27

Yield of Crops in Each Plat, calculated for One Acre.

[Pounds.]

Whole Crop.	Plat I.	Plat II.	Plat III.	Plat IV.	Plat V.
Barley, in drills (matured), .	3,006	3,753	2,975	3,500	2,405
Barley, broadcast (matured), .	2,192	2,459	2,192	2,959	2,658
Dent corn (kernels glazed), .	18,875	19,246	15,461	20,735	19,644

Drilled barley when cut contained 44.4 per cent. of solid matter; corn when cut contained 25.4 per cent. of solid matter.

Conclusion. — The generally fair state of productiveness of the lands at the beginning of the experiment shows itself in the fact that the unfertilized plat (III.) yields but little less than some of the fertilized plats.

1890. — The system of manuring and the general treatment of the soil was the same as in the preceding year.

Name of Crop raised (1890).	Entire Area occupied by Crop.	Area occupied by Crop in Each Plat.
	Acres.	Acres.
Vetch and oats (broadcast), ...	.88	.158
Scotch tares (in drills three feet three inches apart), ...	.81	.146
Soja bean (in drills three feet three inches apart),	2.08	.374

Amount of Seed used per Acre.

Vetch and oats, 80 pounds of oats and 40 pounds of vetch.
Scotch tares in drills, ... 47 pounds.
Soja bean in drills, ... 50 pounds.

Yield of Crops in Each Plat, calculated for One Acre.

[Pounds.]

Whole Crop.	Plat I.	Plat II.	Plat III.	Plat IV.	Plat V.
Vetch and oats (green, blooming when cut), . . .	11,924	8,266	7,190	10,355	11,411
Scotch tares (hayed, blooming when cut), ...	2,842	3,322	1,884	3,219	3,664
Soja bean (green, blooming when cut), ...	9,037	9,556	7,313	10,603	10,305

Vetch and oats when cut contained 20 per cent. dry matter.
Soja bean when cut contained 22 per cent. dry matter.
Scotch tares when cut and dried contained 80 per cent. dry matter.

Conclusions.

1. The effect of the commercial manures applied in case of plats IV. and V. on the yield of crops compares very favorably with that of barn-yard manure (plat I.).

2. Wood ashes have given in our case on the whole quite satisfactory results.

3. The presence in the soil of a liberal amount of organic vegetable matter in all plats, due to the sod turned under (1888–89), has in all probability brought the highest possible manurial effect of wood ashes and commercial fertilizers (plats II., IV., V.).

4. The sulphate of potash-magnesia has given us, in case of leguminous plants, in two out of three cases a better yield of crops than the muriate of potash. The crops are in the majority of cases leguminous plants (clover-like plants).

5. The decline in the yield of the unfertilized as compared with that of the fertilized plats becomes more apparent than in the preceding year.

1891. — The system of manuring and the general treatment of the soil corresponded to that in preceding years.

Name of Crop raised (1891).	Entire Area occupied by the Crop.	Area occupied by the Crop in Each Plat.
	Acres.	Acres.
Barley (in drills two feet apart),	1.68	.302
Oats (in drills two feet apart),	.92	.165
Oats (broadcast),	1.19	.214

Amount of Seed used per Acre.

	Pounds.
Barley, in drills,	68
Oats, in drills,	65
Oats, broadcast,	78

Yield of Crops in Each Plat, calculated for One Acre.

[Pounds.]

		Plat I.	Plat II.	Plat III.	Plat IV.	Plat V.
Barley, in drills,	straw,	2,000	1,952	1,526	2,179	2,219
	grain,	1,113	1,060	692	1,133	1,043
	Total,	3,113	3,012	2,218	3,312	3,262
Oats, in drills,	straw,	2,263	2,558	1,636	2,878	2,448
	grain,	1,248	1,170	729	1,333	1,188
	Total,	3,511	3,728	2,365	4,211	3,636
Oats, broadcast,	straw,	3,192	2,481	1,729	3,140	2,977
	grain,	897	696	467	1,065	991
	Total,	4,089	3,177	2,196	4,205	3,968

Weight of Straw and Grain reduced to a Percentage (1891).

		Plat I.	Plat II.	Plat III.	Plat IV.	Plat V.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Barley, in drills,	straw,	64	65	69	66	68
	grain,	36	35	31	34	32
Oats, in drills,	straw,	64	69	69	68	67
	grain,	36	31	31	32	33
Oats, broadcast,	straw,	78	78	79	75	75
	grain,	22	22	21	25	25

An examination of the above-stated results leads to the following conclusions: —

1. Seeding in drills has in every instance given a larger percentage of grain than seeding broadcast.

2. The yield of the crop on the fertilized plats exceeds as a rule about thirty-three per cent. that of the crop obtained on the unfertilized plat.

3. The results obtained by the aid of commercial manures applied to plats IV. and V. compare very favorably with those obtained with barn-yard manure or wood ashes.

4. Muriate of potash as potash source of plant food in case of grain crops as a rule leads in yield of crops the sulphate of potash-magnesia.

1892. — The system of manuring was the same as in preceding years. The general treatment of the soil was alike in all plats.

Name of Crop raised (1892).	Entire Area occupied by the Crop.	Area occupied by the Crop in Each Plat.
	Acres.	Acres.
Canada peas and oats (broadcast), . . .	.88	.158
Soja bean (in drills two and a half feet apart),	.81	.146
Dent corn, "Pride of the North" (in drills two and a half feet apart, two feet apart in row), .	3.31	.596

Amount of Seed used per Acre.

Canada peas, 2 bushels, and oats, 4 bushels.
Soja beans, ... 60 pounds.
Dent corn, ... 14 quarts (26 to 28 pounds).

Yield of Crop in Each Plat, calculated for One Acre.

[Pounds.]

	Plat I.	Plat II.	Plat III.	Plat IV.	Plat V.
Canada peas and oats (green, in full bloom), ...	–	13,861	11,291	15,101	14,829
Soja bean, ...	*	*	*	*	*
Dent corn — Kernels glazing, . .	25,034	20,025	13,674	†	†
Dent corn — Stover, ...	–	–	–	8,121	8,020
Dent corn — Ears, ...	–	–	–	1,557	1,200

* Not weighed, being fed during August and September.
† Cut for silo.

Dent corn when cut for the silo (kernels glazed but soft) contained from 26 to 28 per cent. of dry vegetable matter; peas and oats when cut (in bloom) contained from 15 to 16 per cent. of dry vegetable matter. As the vetch and oats raised upon the same plats in 1890 contained 20 per cent. of dry matter when cut, it will be seen that this crop under fairly corresponding conditions compares well with that of Canada peas and oats, as far as their yield is concerned.

Analyses of: —

1. Vetch and oats (1890).
2. Canada peas and oats (1892).
3. Early-maturing soja bean (when blooming) (1892).

	Per Cent. 1.	2.	3.
Moisture at 100° C.,	76.21	86.32	72.90
Dry matter,	23.79	13.68	27.10
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	7.25	6.90	11.05
" cellulose,	31.73	26.66	24.73
" fat,	3.37	2.29	7.22
" protein,	7.70	16.01	13.64
Nitrogen-free extract matter,	49.95	48.14	43.36
	100.00	100.00	100.00

1893. — The system of manuring the same as in the preceding year; the general preparation of the soil and of the same crops in all plats alike.

Name of Crop raised (1893).	Entire Area occupied by the Crop.	Area occupied by Crop in Each Plat.
	Acres.	Acres.
Soja bean (broadcast),	1.68	.303
Vetch and oats (broadcast),	1.38	.248
Barley (broadcast),	1.94	.349

Amount of Seed used per Acre.

Soja beans (broadcast), 103 pounds.
Vetch, 50 pounds; oats, 4⅜ bushels.
Barley, 2¼ bushels.

Yield of Crops in Each Plat, calculated per Acre.

[Pounds.]

	Plat I.	Plat II.	Plat III.	Plat IV.	Plat V.
Soja bean (hayed in bloom), . .	3,564	3,498	825	2,442	4,092
Vetch and oats (hayed, cut in full bloom), ...	4,234	5,325	2,944	4,315	6,210
Barley, total (dry, matured), . .	3,837	2,579	2,178	2,894	2,149

A comparison of the yield of all the fertilized plats with that of the yield of the unfertilized plat shows the following difference in yield per acre, in pounds : —

	Plat I.	Plat II.	Plat IV.	Plat V.
1889.				
Barley in drills, ...	31	778	525	—570
Barley broadcast, ...	*	267	767	466
Dent corn (green), ...	3,354	3,785	5,274	4,183
1890.				
Vetch and oats (green), ...	4,734	1,076	3,164	3,221
Scotch tares (hay), ...	958	1,438	1,338	1,780
Soja bean (green), ...	1,724	2,243	3,310	2,992
1891.				
Barley, straw and chaff, ...	474	426	653	693
Barley, grain, ...	421	368	441	351
Oats in drills, straw and chaff, . . .	631	922	1,242	812
Oats in drills, grain, ...	519	441	604	459
Oats broadcast, straw and chaff, . .	1,463	752	1,411	1,248
Oats broadcast, grain, ...	430	229	598	524
1892.				
Canada peas and oats (green), . . .	–	2,570	3,810	3,533
Dent corn (green), ...	11,360	6,351	–	–
1893.				
Soja bean (hay), ...	2,731	2,673	1,617	3,267
Vetch and oats (hay), ...	1,290	2,379	1,371	3,266
Barley (matured, whole crop), . . .	1,659	401	716	—29

* No difference.

Conclusions.

1. Soja beans should be planted in drills, to keep the weeds down. They grow too slowly to shade the ground sufficiently against objectionable vegetation.

2. Vetch and oats yield larger crops, suitable for green fodder, than soja bean, at an early part of the season. They yield also a larger crop of dry fodder for winter use.

3. Both crops, vetch and oats and soja bean, produce a valuable ensilage. Two weight parts of corn, cut when the kernels are glazing, and one weight part of early-maturing soja bean, have furnished us a valuable ensilage for winter and spring use.

1. Analysis of fodder corn for ensilage.
2. Analysis of corn and soja-bean ensilage.

	Per Cent.	
	1.	2.
Moisture at 100° C.,	68.53	77.42
Dry matter,	31.47	22.58
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	5.68	9.72
" cellulose,	22.99	25.01
" fat,	2.81	4.29
" protein,	6.22	6.82
Nitrogen-free extract matter,	62.30	54.16
	100.00	100.00

8. Experiments with Grass Land (Meadows).

The meadows under consideration comprise an area of about 9.6 acres. The entire field to 1886 consisted of old, worn-out grass lands, overrun with a worthless growth on its more elevated portion and covered with weeds and sedges in its lower section. The improving of the land by underdraining and ploughing, and subsequently by the use of a system of drill culture, began in some parts (north end) in 1886 and in others (south end) in 1887. For details of this work, see ninth and tenth annual reports (1891–92).

1893. — In the spring of this year a change was made in the area and mode of manuring of the grass plats. The area was divided into three plats, Plat 1 (3.97 acres) being the area heretofore covered by plats 1 and 2; Plat 2 (2.59 acres) and Plat 3 (3 acres) correspond to plats 3 and 4 of former years.

The system of manuring adopted was as follows: —

Plat 1. — Wood ashes, 1 ton to the acre.
Plat 2. — Barn-yard manure, 8 tons to the acre.
Plat 3. — Six hundred pounds fine-ground bone and 200 pounds muriate of potash to the acre.

Yield of Hay (1893).

	Yield per Plat.			Rate per Acre.		
	Plat 1.	Plat 2.	Plat 3.	Plat 1.	Plat 2.	Plat 3.
First cut, ...	9.60	5.34	5.80	2.28	2.62	1.94
Second cut, ...	2.99	2.22	2.67	.77	.86	.64
Total yield, ...	12.59	7.56	8.47	3.05	3.48	2.58

Yield of Hay (1889–93).

	Rate per Acre (Tons).		
	First Cut.	Second Cut.	Total.
1889.			
Plat 1, barn-yard manure, 18 tons to acre, . .	2.73	1.14	3.87
Plat 2, barn-yard manure, 8 tons to acre, . .	2.38	1.21	3.59
Plat 3, 600 pounds of steamed bone and 200 pounds muriate of potash, ...	2.50	1.03	3.56
1890.			
Plat 1, barn-yard manure, 14 tons to acre, . .	3.80	1.00	4.80
Plat 2, barn-yard manure, 11 tons to acre, . .	3.25	1.34	4.59
Plat 3, as in 1889, ...	3.00	.73	3.73
Plat 4, wood ashes, 1 ton to acre, ...	2.23	.68	2.91
1891.			
Plat 1, barn-yard manure, 8 tons to acre, . .	3.26	.72	3.98
Plat 2, barn-yard manure, 6 tons to acre, . .	2.99	.72	3.71
Plat 3, as in 1890, ...	2.32	.51	2.83
Plat 4, as in 1890, ...	2.32	.51	2.83
1892.			
Plat 1, as in 1891, ...	2.77	1.04	3.81
Plat 2, as in 1891, ...	2.70	.98	3.68
Plat 3, as in 1891, ...	2.33	.64	2.97
Plat 4, as in 1891, ...	2.18	1.02	3.20
1893.			
Plats 1 and 2, wood ashes, 1 ton to acre, . .	2.28	.77	3.05
Plat 3, barn-yard manure, 8 tons to acre, . .	2.62	.86	3.48
Plat 4, 600 pounds ground bone and 200 pounds muriate of potash to acre, ...	1.94	.64	2.58

9. Report on General Farm Work (1893).

The lands assigned for the use of the Massachusetts State Agricultural Experiment Station cover an area of fifty acres. Ten acres are natural woodlands, and forty acres, including the space occupied by the buildings, are used for the raising of farm crops. At present from fifteen to sixteen acres are under cultivation, and from sixteen to seventeen acres are permanent grass lands. As every portion of the land is at present serving for some special experiment, the general management of the farm is to a controlling degree subjected to the requirements of the work called for in connection with the various questions under investigation. The adoption of a thorough mechanical preparation of the soil, supported by a careful, clean cultivation of the crops raised, has brought the lands into a fair condition for field experiments. Each field has had for years its own system of manuring, and becomes thereby from year to year more valuable for experimental purposes. Wherever circumstances have been favorable, forage crops have been chosen, for the purpose of studying the influence of various systems of fertilization and cultivation on their growth and special character. This practice has resulted already in the successful introduction of some valuable forage plants new to our locality, and has also materially assisted us in an economical support of quite extensive experiments in stock feeding. The beneficial effect of many of these crops on the physical and chemical condition of our cultivated lands is everywhere noticed, when compared with their previous general condition.

During the past season several varieties of soja bean, vetch and oats and buckwheat have been raised. The vetch and oats was fed in part green and in part as hay to dairy cows. The soja bean was fed as hay.

Twenty tons of corn have been put into the silos, and the remainder has been fed in part as fodder corn, or has been harvested when matured, and the corn stover obtained will serve for the support of dairy stock in place of hay.

The character and amount of farm and garden crops raised in 1893 may be seen from the following statement : —

	Tons.
Hay (first cut),	$31\frac{1}{3}$
Rowen,	$10\frac{1}{5}$
Potatoes,	$7\frac{1}{2}$
Oats (1,368 pounds grain, 5,032 pounds straw),	$3\frac{1}{5}$
Vetch and oats (hay),	$3\frac{2}{3}$
Vetch and oats (green),	$2\frac{1}{2}$
Fodder corn (green),	$26\frac{1}{2}$
Corn stover,	$5\frac{1}{2}$
Corn (ears),	$2\frac{3}{4}$
Soja bean (hay),	$2\frac{1}{6}$
Barley,	$2\frac{1}{3}$
Rye (226 pounds grain, 1,243 pounds straw),	$\frac{3}{4}$
Buckwheat (green),	$1\frac{1}{4}$
Tomatoes,	$2\frac{1}{4}$
Cabbages,	$1\frac{1}{3}$
Spinach,	$\frac{1}{2}$
Lettuce,	$\frac{1}{6}$
Roots (carrots, 5,540 pounds ; beets, 2,194 pounds ; turnips, 2,157 pounds),	5
Miscellaneous,	3
	$112\frac{9}{10}$

10. On Special Fertilization with Reference to Some Prominent Industrial Crops, Fruits and Garden Vegetables.

One of the first requirements for a healthful condition and subsequent successful propagation of any plant consists in adopting a well-devised system of fertilization.

A system of manuring may be called well devised or rational when it is based upon the results of a careful examination into the composition of the plant under cultivation, and on a due consideration of its natural qualifications for availing itself of the needed plant food both from the atmosphere and the soil in question. When raised under otherwise corresponding circumstances, plants with a well-developed and extensive root system may prosper where those with a compact one will fail; the same statement applies with equal force to the character of their leaf systems.

To ascertain with certainty the composition of a plant, especially with reference to its soil constituents, requires repeated examinations in different stages of its growth and when raised upon different kinds of soil. The relations of the various mineral constituents of the plant to its successful development must be fairly understood to know what elements of plant food ought to be present in the soil, in an available form, to render success possible.

Most of our farm plants have been carefully investigated, and their requirements regarding kind and amount of the various articles of plant food for their successful production may be considered fairly well understood. This circumstance cannot be claimed with the same certainty regarding the so-called "garden crops" and fruit-producing plants. Our stock of information with regard to these is in an exceptional degree unsatisfactory. The slowness of the exhaustive action of fruit trees on the soil, on account of their extensive root systems, and the beneficial effect of a frequent rotation of crops in case of garden plants, in connection with a customary liberal supply of vegetable refuse material and of home-made manures, have apparently delayed the need of a scientific inquiry into the special wants of the garden and

orchard on the part of agricultural chemists. A surplus in the quantity of manurial matter has no doubt quite frequently provided for special wants; and in this view is secured an intelligent explanation of the results. There is no scarcity of valuable testimony to the fact of exceptionally good success in raising fruits and garden crops by the aid of a liberal supply of compound manurial matters, such as barn-yard manure, vegetable compost of various descriptions, wood ashes and others of a similar varying and thus ill-defined composition; yet it is equally well understood that but little satisfactory explanation can be given in many instances regarding the particular relation which exists between the constituents or conditions of such manurial substances applied and the quantity and quality of the crops raised by their aid.

The world-wide reputation of barn-yard manure and wood ashes dates back not merely one or two centuries; their good effects have been known for thousands of years; and we have very good reason to believe that their general reputation rests on their complex character and their beneficial influence over various physical and chemical qualities of the soil. They contain in the majority of cases more or less of all the essential soil constituents which our cultivated farm and garden plants need, and they supply on that account, to some extent at least, not only known but also unknown deficiencies of plant food. They may thus ensure, other circumstances being favorable, for a longer or shorter period of time, reasonable success when applied in suitable quantities.

Experience has shown that refuse manurial matter, like barn-yard manure, is most efficient when used for the reproduction of those crops which contributed materially to its manufacture; a similar view may be maintained with reference to the manurial value of vegetable compost and ashes. The exceptional occurrence of these favorable conditions materially limits, in the light of our present information, their claim of being the best of manures for farm and garden under all circumstances, and needing no further supplementing to meet any special deficiencies of plant food. The whole aspect of the question how to manure efficiently has gradually but decidedly changed within the last fifty years.

We prefer to-day to speak of feeding plants. To secure the best possible results in feeding plants requires information with regard to the three following points: namely, with relation to the physical and chemical character of the soil in question; a knowledge of the special wants of the plant under cultivation, as regards the absolute and relative proportions of the various essential articles of plant food required; and a familiarity with the composition and the general physical properties of the different kinds of manurial matter at our disposal.

A brief statement of the principal results of a systematic, scientific examination into the circumstances which control a healthy and vigorous growth of plants may not be out of place here.

First. All our cultivated plants on the farm, in the garden and in the orchard contain the same elementary constituents, yet no two of them in the same absolute amounts and relative proportions. The list comprises carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, potassium, sodium, calcium, magnesium, silicon, chlorine (manganese?).

Second. These plant constituents are furnished in part by the surrounding atmosphere, in part by the soil, and some in varying proportions by both.

Third. The essential plant constituents are not needed in different plants in the same invariable proportions at the various successive stages of growth, but are wanted at different stages of growth in different absolute amounts and relative proportions. Each kind of plant has its especial wants at different stages of its development. (Grains require much nitrogen in an available form during their later period of growth, when blooming and forming seed, while grape vines need a large amount of potash during the growing and maturing of the fruit, etc)

Fourth. The absolute amount of the essential mineral constituents may vary in the same kind of plant when raised on different soils and in different climates without, as a rule, affecting the general character of the plant; yet it appears, however, that not one of the essential elements can to any extent replace another one without affecting more or less seriously the amount and relative proportion of the organic

constituents of the plant. It has been noticed that many of our cultivated plants are more or less susceptible of change in that direction, owing to a liberal application of one or the other essential constituent.

Fifth. It has also been shown that the particular form of the various articles of plant food, as well as the special associations in which they may be applied, exerts quite frequently a decided influence, not only on the quantity of the crop, but also on its quality.

The observations referred to above (*fourth* and *fifth*) deserve particularly the serious attention of all parties engaged in the raising of industrial crops, as well as garden crops and fruits; in fact, wherever a special quality of the product affects the commercial value of the same. We know that whenever such changes are made they are as apt to be in our favor as against our best interests. The history of the successful production of many of our industrial crops furnishes us with an abundance of illustrations of the existence of such relationships, as in the case of sugar-producing plants, tobacco, etc.

Sixth. The natural resources of the soil in available plant food have proved, as a rule, ultimately insufficient for a remunerative management of the farm, the garden and the orchard. Older systems of agriculture have failed on account of a scanty supply of plant food, and many failures in our present system of management will most likely be ascribed at some future day to an indifferent application of the essentials of plant food.

From the foregoing record of well-established conclusions, derived from actual observation in the vegetation house, the field and the garden, we can draw, if we desire, some valuable lessons for our guidance in the practical management of the various branches of agricultural and horticultural industry.

A careful consideration of the points stated cannot fail to impress all interested parties with the fact that to manure our lands efficiently means to-day something more than to incorporate into the soil an exceptionally liberal amount of some incidental refuse matter of ill-defined composition, as barn-yard manure, vegetable compost or wood ashes. Both good economy and the desirability of securing a successful

and thus economical production of the various farm and garden crops strongly advise the change from an indifferent system of manuring to a more rational one in every branch of agriculture and horticulture.

The steadily increasing consumption of agricultural chemicals and of commercial manurial compounds, for the purpose of supplementing our home resources of manurial matter, is a gratifying endorsement of the good service which systematic, scientific, experimental investigation into the causes of a successful production of remunerative crops have rendered to practical agriculture and horticulture.

Much has thus far been accomplished, considering the short period of time since our views regarding these points have changed; yet much more work is still necessary to secure a reasonably adequate control of the subject under discussion. To promote these interests it seems to be desirable that agricultural chemists render themselves more familiar with the best current modes of a successful horticultural practice, and that horticulturists make themselves familiar with the more recent results of the scientific investigations made in their interests by giving them a fair and careful trial in the practical pursuit of their business.

Every attempt at a rational and remunerative system of cultivation should begin with an inquiry into the location of the lands and the general condition of soil and climate, to ascertain the special fitness of each for the contemplated industry; and, in case the lands have already been under cultivation for years, their past history with regard to the system of cultivation carried on, as well as the character of the crops raised, ought to be consulted before any particular course of operation is decided upon. Inquiries in these directions cannot fail to give us some valuable insight into the character and extent of existing and available circumstances regarding plant food and the possibilities of success.

A due consideration of the character and amount of the existing available plant food of the soil, and some definite information in regard to the composition of the plant we propose to cultivate, ought to guide us in the selection of the kind and the quantity of the manurial substance. As plants require at different stages of growth different quanti-

ties of the essential articles of plant food, it must be the aim to provide a liberal amount of those essential constituents to meet these periodical wants. The well-known fact that liberal manuring pays better than a scanty one finds its explanation in the existence of the above conditions. The heavier the crop the larger should be the return of the constituents carried off from the soil, for that essential article of plant food which is present in the soil in less quantity than the growth of the plant requires controls the final result.

It has been the aim of the writer, since the establishment of the agricultural institutions at Amherst, to furnish object lessons to our farming community in regard to a rational system of fertilization by carrying on a series of field experiments with a variety of farm crops.

The local conditions of the soil with reference to the existing amount of plant food had to be, as far as practicable, determined by actual field trials before the special lines of investigation could be entered upon. Our earlier reports furnish abundant proof of the importance ascribed to a suitable preparation of each experimental plot for the special line of inquiry decided upon.

The natural inherent resources of the soil were usually ascertained by raising for several years in succession, without any manurial addition from outside sources, crops requiring different proportions of the essential articles of plant food, thereby reducing the soil to its normal condition regarding the amount of plant food present, as far as practicable.

Most prominent among the experiments carried on are those with relation to the effect of a liberal supply of the different forms of potash on sugar beets,* sorghum,† grapes,‡ potatoes § and several leguminous and grain crops ; ||

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* See eighth, ninth and eleventh annual reports of the Massachusetts Agricultural College for the years 1871, 1872 and 1874.

† See sixteenth annual report of the Massachusetts Agricultural College for the year 1879.

‡ See thirteenth annual report of the Massachusetts Agricultural College for the year 1876.

§ For details see annual reports of the Board of Control of the Massachusetts State Agricultural Experiment Station for the years 1884-93.

|| For details see annual reports of the Board of Control of the Massachusetts State Agricultural Experiment Station for the years 1884-89.

those with relation to the effect of the different forms of nitrogen (ammonia salts, nitrates and organic nitrogen) on the yield and character of grain crops and leguminous plants; * those to determine the economy of using natural and commercial phosphates in the production of corn and grain crops; † experiments with permanent grass lands (meadows).

Of late our attention has been turned to a special study of the effect of different forms of nitrogen and potassium oxide on the growth of a series of prominent fruit and garden crops, and the results of two years' observations regarding the latter are already reported in detail upon preceding pages (Field C).

To explain the striking differences noticed in the yields of some of those crops, in particular lettuce and tomatoes, when raised with the assistance of either muriate or sulphate of potash, it seemed advisable for confirmation of the results to transfer the investigations to the vegetation house, where, under better-defined circumstances, the special effect of the kind and form of the various articles of plant food supplied could be more clearly demonstrated. A few notes regarding the results thus far obtained are subsequently stated, to invite co-operation on the part of persons interested in the questions involved.

Observations in the plant house with lettuce and spinach, during the winter of 1892–93, were conducted as follows: —

The soil used in the vegetation house was a sandy loam taken a few feet below the surface from a locality which at no time had received an additional supply of manurial matter from an outside source. It was sent through a screen before being used, to remove coarse vegetable matter (roots, etc.) as far as practicable. The beds of the vegetation house were divided into boxes thirty-two inches square and eight inches deep. They were filled with the earth to the depth of six inches, about three hundred pounds being used for the purpose.

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* For details see annual reports of the Board of Control of the Massachusetts State Agricultural Experiment Station for the years 1889–93.

† For details see annual reports of the Board of Control of the Massachusetts State Agricultural Experiment Station for the years 1890–93.

Each box received a fertilizer mixture of its own, nothing but commercial fertilizers and chemicals which had been carefully analyzed being used in their compounding. The amount of potassium oxide, phosphoric acid and nitrogen was the same in each case, the phosphoric acid in all cases being supplied by dissolved bone-black, while the potassium oxide in some cases was in the form of muriate of potash (I., II. and III.), in others of high-grade sulphate (IV., V. and VI.), and in the remainder (VII., VIII. and IX.) by potash-magnesia sulphate. The nitrogen was supplied in the form of sulphate of ammonia (II., IV. and VII.), nitrate of soda (I., V. and VIII.) and dried blood (III., VI. and IX). These fertilizer mixtures were thoroughly incorporated with the soil. Each box was planted in part with lettuce and in part with New Zealand spinach. The same lot of seed sufficed for the whole, and the seeding took place on the same day. Throughout the growing period the boxes were treated similarly, as far as temperature and time and amount of watering were concerned.

The relative proportion of fertilizer applied was: of potassium oxide, 3 parts; of phosphoric acid, 1 part; and of nitrogen, 1 part. The percentage of the different ingredients added to the soil was as follows: —

	Per Cent.
Potassium oxide,	.00026
Phosphoric acid,	.00009
Nitrogen,	.00009

Fertilizer Mixtures used.

Box I.

90 grams muriate of potash.
100 grams dissolved bone-black.
100 grams nitrate of soda.

Box II.

90 grams muriate of potash.
100 grams dissolved bone-black.
100 grams sulphate of ammonia.

Box III.

90 grams muriate of potash.
100 grams dissolved bone-black.
140 grams dried blood.

Box IV.

90 grams sulphate of potash.
100 grams dissolved bone-black.
75 grams sulphate of ammonia.

Box V.

90 grams sulphate of potash.
100 grams dissolved bone-black.
100 grams nitrate of soda.

Box VI.

90 grams sulphate of potash.
100 grams dissolved bone-black.
140 grams dried blood.

Fertilizer Mixtures used — Concluded.

Box VII.

160 grams potash-magnesia sulphate.
100 grams dissolved bone-black.
75 grams sulphate of ammonia.

Box VIII.

160 grams potash-magnesia sulphate.
100 grams dissolved bone-black.
100 grams nitrate of soda.

Box IX.

160 grams potash-magnesia sulphate.
100 grams dissolved bone-black.
140 grams dried blood.

The lettuce seeded in the boxes containing muriate of potash as the potash source proved a complete failure, as the young plants attained a height of only one and one-half inches, the color of the leaves changed into various shades of red, and growth ceased. In the other boxes the results were less striking, but the most satisfactory growth was obtained in those boxes in which sulphate of potash or sulphate of potash-magnesia furnished the source of potash.

Less marked was the difference in growth of the New Zealand spinach, the plants growing in the boxes containing muriate of potash being less vigorous, yet the difference at the close of the experiment was less marked, except in regard to the time required to reach perfection. The most striking thing noticed with regard to these preliminary experiments was in relation to the apparently injurious effect of muriate of potash on lettuce. This result induced us to repeat the experiment in the vegetation house during the winter of 1893–94, for the exact quantities required to give the most beneficial results can obviously only be ascertained by a series of observations.*

* The soil in boxes 1, 2 and 3 was analyzed at the close of the observation, with the following result: —

	No. 1.	No. 2.	No. 3.
	Per Cent.	Per Cent.	Per Cent.
Potassium oxide,	.142	.136	.143
Phosphoric acid,	.119	.137	.163

Observations during the Winter of 1893–94.

The soil turned to account in these experiments was obtained two feet below the surface of an abandoned pasture, which had not received any addition of manurial matter from an outside source for many years.* The soil was screened, thus being freed from coarse material of every description. It consisted of a light loam. Twelve boxes, corresponding in size to those of the previous year (32 by 32 by 8 inches), were employed, each containing about three hundred pounds of the soil, being filled to within one inch of the top. To secure a thorough mixing of the fertilizer and soil, they were worked together with the shovel and the mixture sent twice through the screen. The addition of the fertilizer to the soil was made two weeks in advance of the seeding. A greater variety of fertilizer mixtures was turned to account, including those of the preceding year. The potassium oxide was furnished by muriate of potash (1, 2 and 3), sulphate of potash (4, 5, 6 and 12), carbonate of potash-magnesia (7, 8, 9 and 10) and phosphate of potash (11). The phosphoric acid was supplied by dissolved bone-black (1, 2, 3, 4, 5, 7, 8 and 9), odorless phosphate (6), double superphosphate (10), phosphate of potash (11) and phosphate of ammonia (12). The nitrogen was added in the form of nitrate of soda (1, 4, 7, 10 and 11), sulphate of ammonia (2, 5 and 8), phosphate of ammonia (12) and organic nitrogen (dried blood) (3, 6 and 9). The relative ratio of essential fertilizing constituents applied was four parts potassium oxide, one part phosphoric acid and one part nitrogen. The percentage of the essential elements of plant food applied to the soil was as follows: —

	Per Cent.
Potassium oxide,	.0004
Phosphoric acid,	.0001
Nitrogen,	.0001

Following is a statement of the fertilizer mixtures used: —

* Analysis of this soil showed: moisture, 14.25 per cent.; potassium oxide, .084 per cent.; and phosphoric acid, .134 per cent.

Box 1.

128 grams muriate of potash.
106 grams dissolved bone-black.
106 grams nitrate of soda.

Box 2.

128 grams muriate of potash.
106 grams dissolved bone-black.
78 grams sulphate of ammonia.

Box 3.

128 grams muriate of potash.
100 grams dissolved bone-black.
155 grams dried blood.

Box 4.

128 grams sulphate of potash.
106 grams dissolved bone-black.
106 grams nitrate of soda.

Box 5.

128 grams sulphate of potash.
106 grams dissolved bone-black.
78 grams sulphate of ammonia.

Box 6.

128 grams sulphate of potash.
90 grams odorless phosphate.
155 grams dried blood.

Box 7.

360 grams carbonate of potash-magnesia.
106 grams dissolved bone-black.
106 grams nitrate of soda.

Box 8.

360 grams carbonate of potash-magnesia.
106 grams dissolved bone-black.
78 grams sulphate of ammonia.

Box 9.

360 grams carbonate of potash-magnesia.
100 grams dissolved bone-black.
155 grams dried blood.

Box 10.

136 grams double superphosphate.
360 grams carbonate of potash-magnesia.
106 grams nitrate of soda.

Box 11.

200 grams phosphate of potash.
212 grams nitrate of soda.

Box 12.

145 grams phosphate of ammonia.
128 grams sulphate of potash.

Analyses of chemicals used in compounding the above mixtures will be found below: —

	Potassium Oxide.	Phosphoric Acid.	Nitrogen.
	Per Cent.	Per Cent.	Per Cent.
Muriate of potash,	46.00	–	–
Sulphate of potash,	50.20	–	–
Potash-magnesia sulphate,	24.32	–	–
Carbonate of potash-magnesia,	18.48	–	–
Phosphate of potash,	32.56	35.70	–
Dissolved bone-black,	–	13.88	–
Odorless phosphate,	–	18.42	–
Double superphosphate,	–	47.80	–
Phosphate of ammonia,	–	43.86	10.37
Dried blood,	–	4.02	10.00
Nitrate of soda,	–	–	14.28
Sulphate of ammonia,	–	–	19.59

A greater variety of garden vegetables was selected for trial. Each box was planted on October 11 with seed of the following: —

Lettuce, variety Hanson.
Spinach, variety New Zealand.
Beets, variety Egyptian.
Tomato, variety Essex Hybrid.

The boxes were treated similarly with regard to temperature and time of watering. To control the experiment, part of the vegetation house was turned to account to raise the same varieties of vegetables in the same soil, properly manured with vegetable compost from a successfully managed hot-bed. On October 17 the lettuce and spinach appeared, and by October 20 the remaining seeds had sprouted. The following notes relating to the different garden vegetables on trial may not be without interest in this connection, although still of a preliminary character: —

Lettuce. — The seed germinated well in all cases except with box 12, in which the number was somewhat scanty. During the first two or three weeks of growth the difference in the boxes was not very marked, although on November 20 1, 2 and 3 were noted as being generally of poorer quality than the others, with 4, 5 and 6 next. Nos. 2 and 5 were the poorest in their respective groups, as were the other boxes (8 and 12) in which the nitrogen was furnished by ammonia salts. On December 26 the lettuce was taken from 1, 2, 3, 4, 5 and 6, to make room for other plants; 1, 2 and 3 showed perhaps a less satisfactory growth than the others. January 10 the lettuce was removed from 9 and 10, having made a very satisfactory growth, and on January 10 from 7 and 8, also with a good growth.

Beets. — The seed germinated well in all cases, and during the first part of the growing period no very great differences were observed in the general appearance of the various boxes. The following table gives the heights of the plants at different dates: —

Height of Beets.

[Inches.]

DATE.	BOXES.											
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
December 5,	$2\frac{1}{2}$	$2\frac{3}{4}$	4	$6\frac{1}{2}$	3	$4\frac{3}{4}$	8	$7\frac{1}{2}$	$5\frac{1}{2}$	$8\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$
December 19,	4	$2\frac{3}{4}$	5	$8\frac{1}{2}$	3	6	10	9	7	$9\frac{1}{2}$	$8\frac{1}{2}$	$3\frac{1}{2}$

The plants were taken out of boxes 1, 2, 3, 5 and 6 on December 26, having apparently ceased their growth. They remained longer in box 4, which is provided with an arrangement for sub-irrigation, where they made a slightly larger growth. January 31 the plants were removed from boxes 7, 8, 9, 10 and 11, proving to be the best in 7 and 10.

Spinach. — This crop grew better in proportion in all the boxes than either of the others. In 1, 2 and 3 it made a fair growth, although not as vigorous as in the remaining boxes; 4, 5 and 6 showed a more vigorous and rapid growth, while 7, 8 and 9 proved to be still more vigorous. Boxes 10 and 11 showed a corresponding relative increase in growth, the plants being removed on January 3, when in bloom.

Tomatoes. — The growth of the tomatoes in 1, 2 and 3 was less satisfactory than in most of the others. An opinion regarding the degree of growth under the influence of the different fertilizers may be noticed from the following table, expressing the height of the plants at different periods of the observation: —

Height of Tomato Plants.

[Inches.]

DATE.	BOXES.											
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
December 5,	$5\frac{1}{2}$	$2\frac{3}{4}$	3	[illegible]	5	[illegible]	$6\frac{1}{2}$	$8\frac{1}{2}$	8	$13\frac{1}{2}$	9	$8\frac{1}{2}$
December 19,	$9\frac{1}{2}$	$6\frac{1}{2}$	7	18	10	$11\frac{1}{2}$	11	14	14	24	21	21
January 9,	26	10	25	36	22	22	28	31	32	45	44	43

The plants came in bloom as follows: in box 10, on December 18; in box 11, on December 20; in box 12, on December 23; in boxes 4, 5, 6, 7, 8 and 9 on January 1; and in boxes 1 and 3 on January 3. The plants in box 2 came in bloom February 15.

Fruit was formed first on the plants in box 10, noticed on January 17. It first appeared in box 12 on January 18; in boxes 4 and 9 on January 21; in box 3 on January 24; in box 1 on January 27; in box 8 on February 5; and in box 7 on February 28.

Fruit ripened in box 10 on February 20; in boxes 3, 4 and 12 on February 28; in box 9 on March 1; and in box 8 on March 7.

The plants grown in the soil manured with vegetable compost, as a sort of control experiment, made a very vigorous and healthy growth, but blossomed late and had formed no fruit up to March 8, although retaining their promising appearance.

Besides the above, the investigations during the close of the present winter season have been extended to the following garden vegetables, namely: peas, beans, onions, cauliflower, radish and turnip.

Some General Considerations for Garden Farmers.

1. Garden crops have usually a short period of growth, and for this reason need a soil rich in available plant food of various kinds, to meet periodical wants.

2. An excessive accumulation of half-decayed vegetable matter, as stable manure and compost prepared from the healthy refuse material of the garden, should be guarded against, in order to prevent, as far as practicable, the development of objectionable parasitic growths. Both sources of manurial matter are very valuable in their way, if used in limited quantities and properly supplemented by chemical manures and commercial fertilizers, to meet the special wants of the crops under cultivation.

3. A liberal use of commercial fertilizers and chemical manures for the production of garden vegetables and fruits deserves commendation, for they enable us to meet more directly the special wants of any soil for the production of crops raised in succession during the same season on the same lands. An excessive accumulation of soluble salines has, however, to be avoided, for some garden vegetables, as lettuce, etc., are very sensitive to their influence (see our observation).

4. It is advisable wherever practicable to change the position of different garden crops from season to season, to regulate the accumulation of the various essential constitu-

ents of plant food by raising vegetables consuming them in different proportions.

5. Wherever the quality of a crop controls its economical and commercial value, it seems advisable that care should be taken to secure the exclusion of an accumulation of soluble saline substances not called for by the crop. This circumstance deserves particular attention in cultivation under glass, where the body of soil is limited, and the removal of such substances by percolation to the lower layers offers but little chance of relief. In our experiment above described this view of the question of supplying plant food in the greenhouse has guided us in selecting a series of concentrated chemical manures, which for the above reason are now recommended for patronage.

6. There are, for obvious reasons, no unfailing receipts for a general fertilizer mixture best adapted to all kinds of soil for the production of field and garden crops, yet there are certain relative proportions of the essential articles of plant food which seem to recommend themselves for the raising of vegetables for the market. A mixture containing the proportion of twenty-four per cent. potassium oxide, twelve per cent. phosphoric acid and twelve per cent. nitrogen deserves a careful trial. In some cases it has been found advisable to add nitrogen at different times in small quantities in the form of nitrate of soda. This should be added at different stages of growth, and has been found desirable in the case of cabbages, turnips, cucumbers, onions, lettuce, asparagus, strawberries, grapes, fruit trees, etc. Peas, beans and all leguminous crops need no such addition, for after reaching a certain size they are qualified, by bacterial action upon their roots, to benefit by the elementary nitrogen of the atmosphere in sufficient amounts to secure success.

7. A regular periodical addition of a moderate amount of organic animal and vegetable refuse matter, as barn-yard manure and vegetable compost, may form an efficient part of the system of manuring adopted.

8. It has been found advantageous, in starting the cultivation of garden vegetables and orchards upon new lands, to enrich the lower layers of the soil by deep ploughing, together with the addition of a liberal supply of natural and commercial phosphates (South Carolina, Florida or odorless

phosphates, etc.), a treatment which may be repeated from time to time whenever practicable.

9. A periodical application of burnt lime or carbonate of lime has been found as a rule advantageous to lands used for the cultivation of garden vegetables wherever an excessive accumulation of organic vegetable matter is apt to occur (from one thousand to fifteen hundred pounds per acre may be used). The presence of a liberal amount of calcium carbonate in our cultivated lands is known to assist in many instances in the liberation of plant food from the soil and refuse vegetable material, and also to favor a beneficial bacterial life in the soil under cultivation.

The subsequent tabular statement of the composition of various garden crops, taken from the tables of E. Wolff and from observations made at Amherst, may not be without interest in this connection: —

Relative Proportions of Phosphoric Acid, Potassium Oxide and Nitrogen in Fruits and Garden Crops.

	Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Chenopodiaceæ: —			
Mangolds,	1	6	2.3
*Mangolds,	1	4.2	2.1
Mangold leaves,	1	4.5	3
Sugar beets,	1	4.2	1.8
*Sugar beets,	1	4.8	2.2
Sugar beet tops,	1	2.3	1.7
Sugar beet leaves,	1	5.7	4.3
Sugar beet seed,	1	1.5	–
*Red beets,	1	4.1	3.3
Spinach,	1	1.7	3.1
*Spinach,	1	19.2	6.8
Compositæ: —			
Lettuce,	1	5.3	–
*Lettuce,	1	7.6	4
Head lettuce,	1	3.9	2.2
Roman lettuce,	1	2.3	1.8
*Jerusalem artichoke,	1	2.8	2.7
Convolvulaceæ: —			
Sweet potato,	1	4.6	3

Relative Proportions of Phosphoric Acid, Potassium Oxide and Nitrogen in Fruits and Garden Crops — Continued.

	Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Cruciferæ: —			
White turnips, ...	1	3.6	2.3
*White turnips, ...	1	3.9	1.8
White turnip leaves, . .	1	3.1	3.3
*Ruta-bagas, ...	1	4.1	1.6
Savoy cabbage, ...	1	1.9	2.5
White cabbage, ...	1	4.1	1.7
*White cabbage, ...	1	11.0	7.6
Cauliflower, ...	1	2.3	2.5
Horse-radish, ...	1	3.9	2.2
Radishes, ...	1	3.2	3.8
Kohlrabi, ...	1	1.6	1.8
Cucurbitaceæ: —			
Cucumbers, ...	1	2	1.3
Pumpkins, ...	1	.6	.7
Ericaceæ: —			
*Cranberries, ...	1	3	–
*Cranberries, ...	1	3.4	2.6
Gramineæ: —			
Corn, whole plant, green, .	1	3.7	1.9
*Corn, whole plant, green, .	1	2.2	2.8
Corn kernels, ...	1	.6	2.8
*Corn kernels, ...	1	.6	2.6
*Corn, whole ears, . . .	1	.8	2.5
*Corn stover, ...	1	4.4	3.7
Leguminosæ: —			
Hay of peas, cut green, . .	1	3.4	3.4
*Cow-pea (Dolichos), . . .	1	3.1	2.9
*Small pea (Lathyrus), . .	1	3.4	4.2
Peas (seed), ...	1	1.2	4.3
Pea straw, ...	1	2.8	4
Garden beans (seed), . .	1	1.2	4
Bean straw, ...	1	3.3	–
Liliaceæ: —			
Asparagus, ...	1	1.3	3.6
Onions, ...	1	1.9	2.1
*Onions, ...	1	2.6	–

Relative Proportions of Phosphoric Acid, Potassium Oxide and Nitrogen in Fruits and Garden Crops — Concluded.

	Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Rosaceæ: —			
Apples, ...	1	2.7	2
*Apples, ...	1	1.9	1.3
*Peaches, ...	1	1.3	–
Pears, ...	1	3.6	1.2
Strawberries, ...	1	1.4	–
*Strawberries, ...	1	2.6	–
*Strawberry vines, . . .	1	.7	–
Cherries, ...	1	3.3	–
Plums, ...	1	4.3	–
Saxifragaceæ: —			
*Currants, white, ...	1	2.8	–
*Currants, red, ...	1	2.1	–
Gooseberries, ...	1	1.9	–
Solanaceæ: —			
Potatoes, ...	1	3.6	2.1
*Potatoes, ...	1	4.1	3
Potato tops, nearly ripe, . .	1	2.7	3.1
Potato tops, unripe, . . .	1	3.7	5.3
*Tomatoes, ...	1	8.7	4.5
Tobacco leaves, ...	1	6.2	5.3
Tobacco stalks, ...	1	3.1	2.7
Tobacco stems, ...	1	10.7	3.8
Umbelliferæ: —			
Carrots, ...	1	2.7	2
*Carrots, ...	1	5.7	1.7
Carrot tops, ...	1	2.9	5.1
*Carrot tops, dry, . . .	1	8	5.1
Parsnips, ...	1	3.8	2.8
*Parsnips, ...	1	3.3	1.2
Celery, ...	1	3.5	1.1
Vitaceæ: —			
Grapes, ...	1	3.6	1.2
Grape seed, ...	1	1	2.7

Fertilizing Constituents of Fruits and Garden Crops.

[Average amounts in 1,000 parts of fresh or air-dry substance.]

	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Chenopodiaceæ: —										
Mangolds,	880	1.8	9.1	4.8	1.5	.3	.4	.8	.3	.9
*Mangolds,	873	1.9	12.2	3.8	1.3	.6	.4	.9	–	–
Mangold leaves,	905	3.0	14.6	4.5	2.8	1.6	1.4	1.0	.8	2.3
Sugar beets,	805	1.6	7.1	3.8	.6	.4	.6	.9	.3	.3
*Sugar beets,	869	2.2	10.4	4.8	.8	.6	.4	1.0	.1	–
Sugar beet tops,	840	2.0	9.6	2.8	2.3	.9	1.1	1.2	.2	.3
Sugar beet leaves,	897	3.0	15.3	4.0	2.0	3.1	1.7	.7	.8	1.3
Sugar beet seed,	146	–	45.3	11.1	4.2	10.2	7.3	7.5	2.0	1.9
*Red beets,	877	2.4	11.3	4.4	.9	.5	.3	.9	–	–
Spinach,	903	2.4	16.0	2.7	5.7	1.9	1.0	1.6	1.1	1.0
*Spinach,	922	3.4	9.6	9.6	2.1	.6	.5	.5	–	–
Compositeæ: —										
Lettuce, common,	940	–	8.1	3.7	.8	.5	.2	.7	.3	.4
Head lettuce,	943	2.2	10.3	3.9	.8	1.5	.6	1.0	.4	.8
*Head lettuce,	970	1.2	–	2.3	.2	.3	.1	.3	–	–
Roman lettuce,	925	2.0	9.8	2.5	3.5	1.2	.4	1.1	.4	.4
Artichoke,	811	–	10.1	2.4	.7	1.0	.4	3.9	.5	.2
*Artichoke, Jerusalem,	775	4.6	–	4.8	–	–	–	1.7	–	–
Convolvulaceæ: —										
Sweet potato,	758	2.4	7.4	3.7	.5	.7	.3	.8	.4	.9
Cruciferæ: —										
White turnips,	920	1.8	6.4	2.9	.6	.7	.2	.8	.7	.3
*White turnips,	895	1.8	10.1	3.9	.8	.9	.3	1.0	1.0	–
White turnip leaves,	898	3.0	11.9	2.8	1.1	3.9	.5	.9	1.1	1.2
*Ruta-bagas,	891	1.9	10.6	4.9	.7	.9	.3	1.2	–	–
Savoy cabbage,	871	5.3	14.0	3.9	1.4	3.0	.5	2.1	1.2	1.1
White cabbage,	900	3.0	9.6	4.3	.8	1.2	.4	1.1	1.3	.5
*White cabbage,	984	2.3	–	3.4	.3	.2	.1	.2	–	–
Cabbage leaves,	890	2.4	15.6	5.8	1.5	2.8	.6	1.4	2.4	1.3
Cauliflower,	904	4.0	8.0	3.6	.5	.5	.3	1.6	1.0	.3
Horse-radish,	767	4.3	19.7	7.7	.4	2.0	.4	2.0	4.9	.3
Radishes,	933	1.9	4.9	1.6	1.0	.7	.2	4.5	.3	.5
Kohlrabi,	850	4.8	12.3	4.3	.8	.4	.8	2.7	1.1	.6

Fertilizing Constituents of Fruits and Garden Crops — Continued.

[Average amounts in 1,000 parts of fresh or air-dry substance.]

	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Cucurbitaceæ: —										
Cucumbers,	956	1.6	5.8	2.4	.6	.4	.2	1.2	.4	.4
Pumpkins,	900	1.1	4.4	.9	.9	.3	.2	.7	.3	.4
Ericaceæ: —										
*Cranberries,	996	–	1.8	.9	.1	..3	.1	.3	–	–
*Cranberries,	894	.8	–	1.0	–	.2	.1	.3	–	–
Gramineæ: —										
Corn, whole plant, green,	829	1.9	10.4	3.7	.5	1.4	1.1	1.0	.3	.5
*Corn, whole plant, green,	786	4.1	–	3.8	.5	1.5	.9	1.5	–	–
Corn kernels,	144	16.0	12.4	3.7	.1	.3	1.9	5.7	.1	.2
*Corn kernels,	100	18.2	–	4.0	.3	.3	2.1	7.0	–	–
*Corn, whole ears,	90	14.1	–	4.7	.6	.2	1.8	5.7	–	–
*Corn stover,	282	11.2	37.4	13.2	7.9	5.2	2.6	3.0	–	–
Leguminosæ: —										
Hay of peas, cut green,	167	22.9	62.4	23.2	2.3	15.6	6.3	6.8	5.1	2.0
*Cow-pea (Dolichos), green,	788	2.9	–	3.1	.6	3.0	1.0	1.0	–	–
*Small pea (Lathyrus), dry,	90	38.5	–	25.7	4.7	17.9	5.0	9.0	–	–
Peas (seed),	143	35.8	23.4	10.1	.2	1.1	1.9	8.4	.8	.4
Pea straw,	160	10.4	43.1	9.9	1.8	15.9	3.5	3.5	2.7	2.3
Garden beans (seed),	150	39.0	27.4	12.1	.4	1.5	2.1	9.7	1.1	.3
Bean straw,	166	–	40.2	12.8	3.2	11.1	2.5	3.9	1.7	3.1
Liliaceæ: —										
Asparagus,	933	3.2	5.0	1.2	.9	.6	.2	.9	.3	.3
Onions,	860	2.7	7.4	2.5	.2	1.6	.3	1.3	.4	.2
*Onions,	892	–	4.9	1.8	.1	.4	.2	.7	–	–
Rosaceæ: —										
Apples,	831	.6	2.2	.8	.6	.1	.2	.3	.1	–
*Apples,	799	1.3	4.1	1.9	.3	.3	.3	.1	–	–
*Peaches,	884	–	3.4	2.5	–	.1	.2	.5	–	–
Pears,	831	.6	3.3	1.8	.3	.3	.2	.5	.2	–
Strawberries,	902	–	3.3	.7	.9	.5	–	.5	.1	.1
*Strawberries,	–	–	5.2	2.6	.2	.7	.4	1.0	–	–
*Strawberry vines,	–	–	33.4	3.5	4.5	12.2	1.3	4.8	–	–
Cherries,	825	–	3.9	2.0	.1	.3	.2	.6	.2	.1
Plums,	838	–	2.9	1.7	–	.3	.2	.4	.1	–

Fertilizing Constituents of Fruits and Garden Crops — Concluded.

[Average amounts in 1,000 parts of fresh or air-dry substance.]

	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Saxifragaceæ: —										
*Currants, white,	–	–	5.9	3.1	.2	1.	.3	1.1	–	–
*Currants, red,	871	–	4.1	1.9	.2	.8	.3	.9	–	–
Gooseberries,	903	–	3.3	1.3	.3	.4	.2	.7	–	–
Solanaceæ: —										
Potatoes,	750	3.4	9.5	5.8	.3	.3	.5	1.6	.6	.3
*Potatoes,	798	2.1	9.9	2.9	.1	.1	.2	.7	–	–
Potato tops, nearly ripe,	770	4.9	19.7	4.3	.4	6.4	3.3	1.6	1.3	1.1
Potato tops, unripe,	825	6.3	16.5	4.4	.3	5.1	2.4	1.2	.8	.9
*Tomatoes,	940	1.7	–	3.6	–	.3	.2	.4	–	–
Tobacco leaves,	180	34.8	140.7	40.7	4.5	50.7	10.4	6.6	8.5	9.4
Tobacco stalks,	180	24.6	64.7	28.2	6.6	12.4	.5	9.2	2.2	2.4
*Tobacco stems,	106	22.9	140.7	64.6	3.4	38.9	12.3	6.0	–	–
Umbelliferæ: —										
Carrots,	850	2.2	8.2	3.0	1.7	.9	.4	1.1	.5	.4
*Carrots,	898	1.5	9.2	5.1	.6	.7	.2	.9	–	–
Carrot tops,	822	5.1	23.9	2.9	4.7	7.9	.8	1.0	1.8	2.4
Carrot tops, dry,	98	31.3	125.2	48.8	40.3	20.9	6.7	6.1	–	–
Parsnips,	793	5.4	10.0	5.4	.2	1.1	.6	1.9	.5	.4
*Parsnips,	803	2.2	–	6.2	.1	.9	.5	1.9	–	–
Celery,	841	2.4	17.6	7.6	–	2.3	1.0	2.2	1.0	2.8
Vitaceæ: —										
Grapes,	830	1.7	8.8	5.0	.1	1.0	.4	1.4	.5	.1
Grape seed,	110	19.0	22.7	6.9	.5	5.6	1.4	7.0	.8	.1

Most of the foregoing analyses were compiled from the tables of E. Wolff. Those marked * are from analyses made at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

PART III.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

C. A. GOESSMANN.

I.

COMMUNICATION ON COMMERCIAL FERTILIZERS.

1. General introduction.
2. State laws for the regulation of trade in commercial fertilizers.
3. List of licensed manufacturers and dealers from May 1, 1893, to May 1, 1894.
4. Analyses of licensed fertilizers.
5. Analyses of commercial fertilizers and manurial substances sent on for examination.
6. Miscellaneous analyses.
7. Miscellaneous fodder analyses.

1. General Introduction.

Fifty-two manufacturers and dealers have applied for and received licenses for the sale of their various brands in our State. Twenty-four of them are residents of other States.

Two hundred and thirty-five samples of licensed articles have been collected in all parts of the State by authorized agents of the station. Two hundred and fourteen of them have been carefully analyzed at the chemical laboratory of the station, with the following results: one sample contained all three essential constituents above the highest guarantee; seventeen samples contained two of the essential elements above the highest guarantee; forty-five contained one essential element above the highest guarantee; sixty-eight contained three essential elements at the lowest guarantee; fifty-seven contained two essential elements at the lowest guarantee; thirty-one contained one element at lowest guarantee; one sample contained three essential elements below the lowest stated guarantee; fourteen samples contained two essential elements below the lowest stated guarantee; fifty-one contained one element below the lowest stated guarantee.

The deficiency in one or two essential constituents was in the majority of instances compensated for by an excess in the others.

The variations in the market price of prominent fertilizer constituents have been, on the whole, during the past year within the usual limits. Phosphoric acid in all forms has been offered at a somewhat lower figure than last year, while nitrogen in its leading forms has been somewhat higher.

The duties assigned to the director of the station, to act as inspector of commercial fertilizers, render it necessary to *discriminate*, in official publications of the results of analyses of commercial fertilizers and of manurial substances in general made at the station, *between analyses of samples collected by a duly qualified delegate of the experiment station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties.* In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

The official report of analyses of compound fertilizers and of all such materials as are to be used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted by our State laws to a statement of chemical composition and to such additional information as relates to the latter.

The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents has, therefore, been discontinued. This change, it is expected, will tend to direct the attention of the consumers of fertilizers more forcibly towards a *consideration of the particular composition of the different brands of fertilizers offered for their patronage, a circumstance not infrequently overlooked.*

The *approximate market value* of the different brands of fertilizers obtained by the current mode of valuation does not express *their respective agricultural value, i. e.*, their crop-producing value; for the higher or lower market price

of different brands of fertilizers does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated and the special wants of the crops to be raised by their assistance.

To select judiciously from among the various brands of fertilizers offered for patronage requires, in the main, two kinds of information, namely, we ought to feel confident that the particular brand of fertilizer in question actually contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost, and that it contains them in such form and such proportions as will best meet existing circumstances and special wants. In some cases it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three. A remunerative use of commercial fertilizers can only be secured by attending carefully to the above-stated considerations.

To assist farmers not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for their commercial valuation, are once more stated within a few subsequent pages.

The hitherto customary valuation of manurial substances is based on the average trade value of the essential fertilizing elements specified by analysis. The money value of the higher grades of agricultural chemicals and of the higher-priced compound fertilizers depends, in the majority of cases, on the amount and the particular form of two or three essential articles of plant food, *i. e.*, phosphoric acid, nitrogen and potash, which they contain. To ascertain by this mode of valuation the approximate market value of a fertilizer (*i. e.*, the money worth of its essential fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound; the same course is adopted with reference to the various forms of phosphoric acid and of potassium oxide. We thus get the values per ton of the several ingredients, and, adding them together,

we obtain the total valuation per ton in case of cash payment at points of general distribution.

The market value of low-priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse and waste materials of different description, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from fifty to one hundred per cent. in commercial value on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals, 1893.

	Cents per Pound.
Nitrogen in ammonia salts,	17
Nitrogen in nitrates,	15½
Organic nitrogen in dry and fine-ground fish, meat, blood, and in high-grade mixed fertilizers,	17½
Organic nitrogen in cotton-seed meal, linseed meal and castor pomace,	16½
Organic nitrogen in fine-ground bone and tankage,	15
Organic nitrogen in fine-ground medium bone and tankage,	12

Trade Values of Fertilizing Ingredients, etc. — Concluded.

	Cents per Pound.
Organic nitrogen in medium bone and tankage,	9
Organic nitrogen in coarse bone and tankage,	7
Organic nitrogen in hair, horn shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	6½
Phosphoric acid soluble in ammonium citrate,	6
Phosphoric acid in fine bone and tankage,	6
Phosphoric acid in fine medium bone and tankage,	5
Phosphoric acid in medium bone and tankage,	4
Phosphoric acid in coarse bone and tankage,	3
Phosphoric acid in fine-ground fish, cotton-seed meal, linseed meal, castor pomace and wood ashes,	5
Phosphoric acid insoluble (in ammonium citrate) in mixed fertilizers,	2
Potash as high-grade sulphate, and in mixtures free from muriate,	5½
Potash as muriate,	4½

The manurial constituents contained in feed stuffs are valued as follows: —

	Cents per Pound.
Organic nitrogen,	17½
Phosphoric acid,	5
Potash,	5½

The organic nitrogen in *superphosphates, special manures and mixed fertilizers of a high grade* is usually valued at the highest figures laid down in the trade values of fertilizing ingredients in raw materials, namely, fifteen and a half cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones or other equally good forms, and not from leather, shoddy, hair or any low-priced, inferior form of vegetable matter, unless the contrary is ascertained. The insoluble phosphoric acid is valued in this connection at two cents.

The above trade values are the figures at which, in the six months preceding March, 1893, the respective ingredients could be bought at *retail for cash in our large markets, in the raw materials*, which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1, plus about twenty per cent.

in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the retail price at the large markets of standard raw materials, such as : —

Sulphate of ammonia,	Dry ground fish,
Nitrate of soda,	Azotin,
Muriate of potash,	Ammonite,
Sulphate of potash,	Castor pomace,
Dried blood,	Bone and tankage,
Dried ground meat,	Plain superphosphates.

A large percentage of commercial materials consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industries is liable to affect at any time, more or less seriously, the composition of the refuse. To assist the farming community in a clear and intelligent appreciation of the various substances sold for manurial purposes, a frequent examination into the temporary characters of agricultural chemicals and refuse materials offered in our markets for manurial purposes is constantly carried on at the laboratory of the station.

Consumers of commercial manurial substances do well to buy, whenever practicable, on guarantee of composition with reference to their essential constituents, and to see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent.

Our present laws for the regulation of the trade in commercial fertilizers include not only the various brands of compound fertilizers, but also all materials, single or compound, without reference to source, used for manurial purposes when offered for sale in our market at ten dollars or more per ton. Copies of our present laws for the regulation of the trade in commercial fertilizers may be had by all interested, on application at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

2. The Provisions of the Act are as follows:

[Chapter 296.]

An Act to regulate the sale of commercial fertilizers.

Be it enacted, etc., as follows:

Section 1. Every lot or parcel of commercial fertilizer or material used for manurial purposes sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

Sect. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

Sect. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients: namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of

said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

SECT. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure and to accompany or go with every parcel or lot of the same.

SECT. 5. Any person selling, offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence, and one hundred dollars for each subsequent offence.

SECT. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

SECT. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relates only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest or their representative, and taken from a parcel or a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said sample; one of

said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be found substantially equivalent to the statement of analysis made by the manufacturer or importer.

SECT. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

SECT. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*]

Instructions to Manufacturers, Importers, Agents and Sellers of Commercial Fertilizers or Materials used for Manurial Purposes in Massachusetts.

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this State must be accompanied: —

First, with a distinct statement of the name of each brand offered for sale.

Second, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide guaranteed in each distinct brand.

Third, with the fee charged by the State for a certificate, which is five dollars for each of the following articles, nitrogen, phosphoric acid and potassium oxide, guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to compound fertilizers but to all substances, single or compound, used for manurial purposes, and offered for sale at ten dollars or more per ton of two thousand pounds.

3. The certificate must be secured annually before the first of May.

4. Manufacturers, importers and dealers in commercial fertilizers can appoint in this State as many agents as they

desire, after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers are held personally responsible for their transactions until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and importers are requested to furnish a list of their agents.

7. All applications for certificates should be addressed to the Director of the Massachusetts State Agricultural Experiment Station.

Arrangements are made, as in previous years, to attend to the examination of objects of general interest to the farming community, to the full extent of existing resources. Requests for analyses of substances — as fodder articles, fertilizers, etc. — coming through officers of agricultural societies and farmers' clubs within the State will receive hereafter, as in the past, first attention, and in the order that the applications arrive at the office of the station. The results will be returned without a charge for the services rendered. Application of private parties for analyses of substances, free of charge, will receive a careful consideration whenever the results promise to be of a more general interest. For obvious reasons, no work can be carried on at the station of which the results are not at the disposal of the managers for publication, if deemed advisable in the interest of the citizens of the State.

All parcels and communications sent to "The Massachusetts State Experiment Station" must have express and postal charges prepaid, to receive attention.

3. List of Manufacturers and Dealers who have secured Certificates for the Sale of Commercial Fertilizers in this State during the Past Year (May 1, 1893, to May 1, 1894) and the Brands licensed by Each.

Allison, Stroup & Co., New York, N. Y.: —
Odorless Phosphate.
Canada Wood Ashes.

Ames Fertilizer Company, Peabody, Mass.: —
Plymouth Rock Brand.
Special Potato Fertilizer.
Pure Fine Bone.

H. J. Baker & Bro., New York, N. Y.: —
"A A" Ammoniated Superphosphate.
Special Potato Manure.
Special Grass Manure.
Special Tobacco Manure.
Special Corn Manure.
Pure Ground Bone.

C. A. Bartlett, Worcester, Mass.: —
Ground Bone.
Animal Fertilizer.

Bowker Fertilizer Company, Boston, Mass.: —
Stockbridge Special Manures.
Bowker's Hill and Drill Phosphate.
Bowker's Farm and Garden Phosphate, or Ammoniated Bone.
Bowker's Lawn and Garden Dressing.
Bowker's Fish and Potash.
Bowker's Potato and Vegetable Manure.
Bowker's Sure Crop Bone Phosphate.
Gloucester Fish and Potash.
Bowker's Dried Ground Fish.
Bowker's Fresh Ground Bone.
Nitrate of Soda.
Dried Blood.
Dissolved Bone-black.
Muriate of Potash.
Sulphate of Potash.

Bradley Fertilizer Company, Boston, Mass.: —
- Bradley's XL Phosphate.
- BD Sea Fowl Guano.
- Bradley's Potato Manure.
- Original Coe's Superphosphate.
- Bradley's Complete Manures.
- Breck's Fertilizer.
- High-grade Tobacco Manure.
- Bradley's English Lawn Fertilizer.
- Farmer's New Method Fertilizer.
- Bradley's Fish and Potash.
- Bradley's Pure Fine-ground Bone.
- Dissolved Bone-black.
- Nitrate of Soda.
- Sulphate of Ammonia.
- Muriate of Potash.
- Sulphate of Potash.

W. J. Brightman & Co., Tiverton, R. I.: —
- Dry Ground Fish.
- Fish and Potash.
- Superphosphate.

Bryant & Brett, New Bedford, Mass.: —
- Ground Bone.

Burgess & Roy, South Attleborough, Mass.: —
- Animal Fertilizer.

Joseph Church & Co., Tiverton, R. I.: —
- Special Fertilizer (B Brand).
- Standard Fertilizer (C Brand).
- Fish and Potash (D Brand).

Clark's Cove Fertilizer Company, Boston, Mass.: —
- Bay State Fertilizer.
- Bay State Fertilizer, G. G.
- Great Planet "A" Manure.
- King Philip Guano.
- Potato and Tobacco Fertilizer.
- Fish and Potash.

Clark's Cove Fertilizer Company, Boston, Mass. — *Concluded.*
- Tobacco Fertilizer.
- Ground Bone.
- Potato Manure.
- Muriate of Potash.
- Nitrate of Soda.
- Sulphate of Potash.

Cleveland Dryer Company, Boston, Mass. : —
- Cleveland Superphosphate.
- Cleveland Potato Phosphate.
- Cleveland Corn and Grain Phosphate.
- Cleveland Fertilizer.

Cleveland Linseed Oil Company, Cleveland, O. : —
- Tobacco Fertilizer.

E. Frank Coe, New York, N. Y. : —
- Alkaline Bone Phosphate.
- Special Tobacco Fertilizer.
- Potato Fertilizer.
- Ammoniated Bone Superphosphate.
- Fish Guano and Potash.
- Gold Brand Excelsior Guano.
- Red Brand Excelsior Guano.

Crocker Fertilizer and Chemical Company, Buffalo, N. Y. : —
- Ammoniated Bone Superphosphate.
- Potato, Tobacco and Hop Phosphate.
- Special Potato Manure.
- Ammoniated Wheat and Corn Phosphate.
- New Rival Ammoniated Superphosphate.
- Ammoniated Practical Superphosphate.
- Vegetable Bone Superphosphate.
- Lawn Fertilizer.
- Pure Ground Bone.
- Ground Bone Meal.

Cumberland Bone Company, Portland, Me. : —
- Cumberland Superphosphate.
- Cumberland Potato Fertilizer.
- Cumberland Fertilizer.

L. B. Darling Fertilizer Company, Pawtucket, R. I.: —
- Darling's Animal Fertilizer.
- Darling's Extra Bone Phosphate.
- Darling's Potato and Root Crop Fertilizer.
- Darling's Lawn and Garden Fertilizer.
- Darling's Tobacco Grower.
- Darling's Pure Fine Bone.
- Darling's Pure Dissolved Bone.

John C. Dow & Co., Boston, Mass.: —
- Dow's Ground Bone Fertilizer.
- Dow's Nitrogenous Superphosphate.
- Dow's Ground Bone.

Forest City Wood Ash Company, Boston, Mass.: —
- Canada Unleached Hardwood Ashes.

William E. Fyfe & Co., Clinton, Mass.: —
- Star Brand Canada Wood Ashes.

Great Eastern Fertilizer Company, Rutland, Vt.: —
- Great Eastern General, for Grass and Grain.
- Great Eastern Vegetable, Vine and Tobacco Fertilizer.
- Great Eastern General, Oats, Buckwheat and Seeding-down Phosphate.

James J. H. Gregory & Son, Marblehead, Mass.: —
- Gregory's Combination Fertilizer.
- Gregory's Corn Fertilizer.
- Gregory's Potato Fertilizer.

Hargraves' Manufacturing Company, Fall River, Mass.: —
- Ground Bone.

Edmund Hersey, Hingham, Mass.: —
- Fine-ground Bone.

Thomas Hersom & Co., New Bedford, Mass.: —
- Meat and Bone.
- Bone Meal.

John G. Jefferds, Worcester, Mass. : —
  Animal Fertilizer.
  Potato Manure.
  Ground Bone.

John Joynt, St. Helens, Ont. : —
  Canada Hardwood Unleached Ashes.

F. R. Lalor, Dunnville, Ont. : —
  Canada Hardwood Ashes (Maple Brand).

A. Lee & Co., Lawrence, Mass. : —
  Lawrence Fertilizer.

Lowell Bone Fertilizer Company, Lowell, Mass. : —
  Lowell Bone Fertilizer.

Mapes Formula and Peruvian Guano Company, New York, N.Y. : —
  Mapes Superphosphates.
  Mapes Special Crop Manures.
  Peruvian Guanos.
  Bone Manures.
  Sulphate of Potash.

James E. McGovern, Lawrence, Mass. : —
  Ground Bone.
  West Andover Market Bone Phosphate.

Monroe, DeForest & Co., Oswego, N. Y. : —
  Hardwood Ashes.

National Fertilizer Company, Bridgeport, Conn. : —
  Chittenden's Complete Fertilizers.
  Chittenden's Universal Phosphate.
  Chittenden's Fish and Potash.
  Chittenden's Ground Bone.

Pacific Guano Company, Boston, Mass. : —
  Pacific Guano.
  Potato Manure.
  Potato and Tobacco Fertilizer.
  Fish and Potash.
  High-grade General Fertilizer.

John J. Peters, Long Island City, N. Y.: —
Sheep Fertilizer.

Prentiss, Brooks & Co., Holyoke, Mass.: —
Complete Manures.
Phosphate.
Tankage.
Dissolved Bone-black.
Nitrate of Soda.
Muriate of Potash.

Preston Fertilizer Company, Greenpoint, Long Island: —
Ammoniated Bone Superphosphate.

Quinnipiac Fertilizer Company, Boston, Mass.: —
Quinnipiac Phosphate.
Quinnipiac Potato Manure.
Quinnipiac Market Garden Manure.
Quinnipiac Corn Manure.
Quinnipiac Fish and Potash (Crossed Fishes).
Quinnipiac Fish and Potash (Plain).
Quinnipiac Havana Fertilizer.
Quinnipiac Onion Manure.
Quinnipiac Bone Meal.
Quinnipiac Grass Fertilizer.
Quinnipiac Dry Ground Fish.
Quinnipiac Potato and Tobacco Fertilizer.
Sulphate of Potash.
Muriate of Potash.
Nitrate of Soda.

The Read Fertilizer Company, Syracuse, N. Y.: —
Read's Standard Phosphate.
H. G. Farmer's Friend.
Fish and Potash.
Vegetable and Vine Phosphate.

John S. Reese & Co., Baltimore, Md.: —
New England Favorite.
Potato Special.
Pilgrim.
Mayflower.
Columbus A.

Lucien Sanderson, New Haven, Conn.: —
Formula A.
Formula B.
H. G. Sulphate of Potash.
Sulphate Potash-magnesia.
Dry Ground Fish.
Blood, Meat and Bone.
Dissolved Bone-black.
Nitrate of Soda.
Muriate of Potash.

Edward H. Smith, Northborough, Mass.: —
Ground Bone.

Springfield Provision Company, Brightwood, Mass.: —
Blood, Meat and Bone.

Standard Fertilizer Company, Boston, Mass.: —
Superphosphate.
Standard Fertilizer.
Potato and Tobacco Fertilizer.
Complete Manure.
Standard Guano.

Chas. Stevens, Napanee, Ont.: —
"Beaver Brand" Canada Hardwood Ashes.

F. C. Sturtevant, Hartford, Conn.: —
Sturtevant's Tobacco and Sulphur.

J. A. Tucker & Co., Boston, Mass.: —
Original Bay State Bone Superphosphate.
Imperial Bone Superphosphate.

Walker, Stratman & Co., Pittsburg, Pa.: —
Potato Special.
Tobacco Special.
Banner Fertilizer.
Four-fold Fertilizer.

Whittemore Bros., Wayland, Mass.: —
Whittemore's Complete Manure.

Leander Wilcox, Mystic, Conn.: —
Potato, Onion and Tobacco Manure.
Ammoniated Bone Phosphate.
H. G. Fish and Potash.
Dry Ground Fish Guano.

Williams & Clark Fertilizer Company, Boston, Mass.: —
Ammoniated Bone Superphosphate.
Universal Ammoniated Dissolved Bone.
High-grade Special.
Lawn Dressing.
Potato and Tobacco Manure.
Fine Wrapper Tobacco Grower.
Royal Bone Phosphate.
Prolific Crop Producer.
Potato Phosphate.
Corn Phosphate.
Grass Manure.
Onion Manure.
Pure Bone Meal.
Dry Ground Fish.
Fish and Potash.
Dissolved Bone-black.
Nitrate of Soda.
Muriate of Potash.
Sulphate of Potash.

4. Analyses of Licensed Fertilizers collected during 1893 in the General Markets by the Agent of the Massachusetts State Agricultural Experiment Station.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at—
	Compound Fertilizers.		
9	Potato Phosphate,	Williams & Clark Fertilizer Company, Boston, Mass.,	Hadley.
10	Dry Ground Fish,	Williams & Clark Fertilizer Company, Boston, Mass.,	Hadley.
12	XL Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	Springfield.
13	Potato Phosphate,	Williams & Clark Fertilizer Company, Boston, Mass.,	Springfield.
14	Potato Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	Springfield.
19	Blood, Meat and Bone,	Springfield Provision Company, Brightwood, Mass.,	Brightwood.
40	XL Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	Worcester.
55	Castor Pomace,	H. J. Baker & Bro., New York, N. Y.,	Amherst.
64	Sheep Fertilizer,	John J. Peters, Long Island City, N. Y.,	Boston.
69	Canada Unleached Wood Ashes,	Forest City Wood Ash Company, London, Ont.,	Boston.
71	Complete Corn and Grain Manure,	Bradley Fertilizer Company, Boston, Mass.,	Boston.
73	Pacific Guano,	Pacific Guano Company, Boston, Mass.,	Newburyport.
100	King Philip Guano,	Clark's Cove Fertilizer Company, Boston, Mass.,	Lawrence.
102	Potato Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	Fitchburg.
106	Potato, Hop and Tobacco Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Lowell.

108	Vegetable, Vine and Tobacco Fertilizer,	Great Eastern Fertilizer Company, Rutland, Vt.,	Mansfield.
110	High-grade Potato Fertilizer,	E. Frank Coe, New York, N. Y.,	Palmer.
150	Potato, Hop and Tobacco Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
171	Pilgrim Fertilizer,	John S. Reese & Co., Baltimore, Md.,	Pittsfield.
225	Canada Unleached Wood Ashes,	Forest City Wood Ash Company, London, Ont.,	Amherst.
226	South Carolina Floats,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
227	Cotton-seed Meal,	(Agent) S. P. Puffer, North Amherst, Mass.,	North Amherst.
228	Linseed Meal,	Cleveland Linseed Oil Company, Cleveland, Ohio,	Amherst.
229	Odorless Phosphate,	Pottstown Iron Company, Pottstown, Penn.,	Amherst.
	Chemicals.		
50	High-grade Sulphate of Potash,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
52	Sulphate of Ammonia,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
53	Dried Blood,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
57	Nitrate of Potash,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
	Bones.		
49	Steamed Fine-ground Bone,	Edward H. Smith, Northborough, Mass.,	Amherst.
81	Pure Ground Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Fitchburg.
148	Ground Bone,	Edmund Hersey, Hingham, Mass.,	Amherst.
155	Pure Ground Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.

4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
9, 13	Potato Phospate,	14.56	2.80	2.47—3.30	4.39	2.07	1.77	8.23	7—11	6.46	6—9	6.03	5—6
10	Dry Ground Fish,	10.62	8.86	7.41—9.06	1.11	3.68	2.05	6.84	7—9	4.79	-	-	-
12, 40	XL Superphosphate of Lime,	14.85	2.78	2.50—3.25	7.55	2.05	2.17	11.77	11—14	9.60	9—11	2.45	2—3
14, 102	Potato Manure,	14.70	2.33	2.47—3.30	4.30	1.84	1.74	7.88	7—11	6.14	6—9	5.22	5—6*
19	Blood, Meat and Bone,	11.68	8.04	7—8	.36	5.17	3.58	9.11	9.5—10.5	5.53	-	-	-
55	Castor Pomace,	10.08	5.60	5—6	-	-	-	2.26	-	-	-	3.40	-
64	Sheep Fertilizer,	29.07	2.01	1.65	-	-	-	1.22	1.20	-	-	2.38	1.70
69, 225	Canada Unleached Wood Ashes,	10.84	-	-	-	-	-	1.38	1.5—2.5	-	-	6.25	4.5—8
71	Complete Corn and Grain Manure,	10.60	3.02	3.30—4.12	2.94	10.31	2.61	15.86	13—15	13.25	12—14	5.50	3—4
73	Pacific Guano,	17.52	2.22	2.25—3	6.45	3.21	.70	10.36	10.50—16	9.66	8.5—12	2.00	2—3

100	King Philip Guano,	17.69	1.23	1.03—1.64	6.40	2.30	1.02	9.72	9—12	8.70	8—10	2.13	2—3
106, 150	Potato, Hop and Tobacco Phosphate,	14.08	2.62	2.1—3.2	7.68	1.66	1.41	10.75	10—12	9.34	10—12	3.53	3.2—4.3*
108	Vegetable, Vine and Tobacco Fertilizer,	14.74	2.28	2.06—2.88	7.16	1.12	.90	9.18	8—12	8.28	8—12	5.74	6—8
110	High-grade Potato Fertilizer,	11.25	1.75	2—2.5	5.88	1.90	1.74	9.52	10—13	7.78	8—10	5.27	6—7*
171	Pilgrim Fertilizer,	17.34	.89	1.23—2.70	3.45	4.10	1.02	8.57	7.5—10.5	7.55	6.5—8	3.36	3—4
226	South Carolina Floats,	.83	–	–	–	2.33	21.06	23.39	–	2.33	–	–	–
227	Cotton-seed Meal,	8.65	6.50	–	–	–	–	3.17	–	–	–	2.25	–
228	Linseed Meal,	10.43	5.91	5.80—6.20	–	–	–	1.95	1.98—2.20	–	–	1.08	1.30—1.50
229	Odorless Phosphate,	.63	–	–	–	–	–	18.42	18.00	–	–	–	–
	Chemicals.												
50	High-grade Sulphate of Potash,	1.36	–	–	–	–	–	–	–	–	–	50.20	48—52
52	Sulphate of Ammonia,	1.50	19.59	19.78—20.60	–	–	–	–	–	–	–	–	–
53	Dried Blood,	7.69	10	9.06—10.71	–	–	–	4.02	–	–	–	–	–
57	Nitrate of Potash,	1.80	12.79	12.57	–	–	–	–	–	–	–	45.04	41.88

												Mechanical Analysis.			
	Bones.											Fine.	Med. Fine.	Med.	Coarse Med.
49	Steamed Fine-ground Bone,	4.85	4.02	4.02	.29	9.77	12.90	22.96	22.96	10.06	10.06	40.70	41.24	18.06	–
81, 155	Pure Ground Bone,	5.82	3.89	2.9—3.7	.13	10.61	15.36	26.10	25.00	10.74	–	36.32	30.00	25.50	8.18
148	Ground Bone,	3.34	3.13	3—4	.13	13.95	10.36	24.44	19.25	14.08	–	51.72	14.89	20.91	12.48

* Sulphate of potash, the source of potash.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
1	Potato Special,	Walker, Stratman & Co., Pittsburg, Pa.,	Amherst.
11	Hampden Lawn Dressing,	Bradley Fertilizer Company, Boston, Mass.,	Springfield.
17	Ammoniated Bone Superphosphate,	Williams & Clark, Boston, Mass.,	Springfield.
18	Fish and Potash (Crossed Fish Brand),	Quinnipiac Fertilizer Company, Boston, Mass.,	Springfield.
28	Complete Manure for Potatoes and Root Crops,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
32	Stockbridge Complete Manure for Potatoes and Vegetables,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
34	Fish and Potash (D Brand),	Joseph Church & Co., Tiverton, R. I.,	Springfield.
36	Complete Potato Manure,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
42	Animal Fertilizer,	J. G. Jefferds, Worcester, Mass.,	Worcester.
65	Complete Animal Fertilizer,	C. A. Bartlett, Worcester, Mass.,	Boston.
76	English Lawn Dressing,	Bradley Fertilizer Company, Boston, Mass.,	Lowell.
77	Bay State Fertilizer,	Clark's Cove Fertilizer Company, Boston, Mass.,	Lawrence.
80	Lawrence Fertilizer,	A. Lee & Co., Boston, Mass.,	Lawrence.
82	Animal Fertilizer,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Lowell.
86	Special Potato Manure,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Fitchburg.
90	Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Lowell.
98	English Lawn Dressing,	Bradley Fertilizer Company, Boston, Mass.,	Fitchburg.

129	Ammoniated Bone Superphosphate,	Williams & Clark, Boston, Mass.,	Dighton.
141	Bay State Fertilizer,	Clark's Cove Fertilizer Company, Boston, Mass.,	Dighton.
147	Fish and Potash (D Braud),	Joseph Church & Co., Tiverton, R. I.,	Taunton.
153	Special Potato Manure,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
157	Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
199	Special Potato Manure,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	North Adams.
201	Potato Special,	Walker, Stratman & Co., Pittsburg, Pa.,	Leeds.
	Bones.		
24	Fine-ground Bone,	Gilbert E. Holmes, Worcester, Mass.,	Worcester.
83	Ground Bone Meal,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Fitchburg.
124	Ground Bone,	Hargraves Manufacturing Company, Fall River, Mass.,	Fall River.
127	Fine-ground Bone,	Bryant & Brett, New Bedford, Mass.,	New Bedford.
128	Pure Bone Meal,	Thomas Hersom & Co., New Bedford, Mass ,	New Bedford.
154	Ground Bone Meal,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
215	Fine-ground Bone,	Bryant & Brett, New Bedford, Mass.,	Amherst.

4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
1, 201	Potato Special,	11.70	1.72	2.47—3.30	5.12	2.54	5.90	13.56	12—13	7.66	10—11	7.01	5—6
11	Hampden Lawn Dressing,	8.16	4.86	3.30—4.12	1.41	3.58	1.92	6.91	.7—9	4.99	6—8	3.13	2—3
17, 129	Ammoniated Bone Superphosphate,	12.98	2.47	2.47—3.30	7.55	2.94	1.28	11.77	10—13	10.49	9—11	2.11	2—3
18	Fish and Potash (Crossed Fish Brand),	21.05	4.90	3.30—4.12	2.35	2.55	2.26	7.16	5—8	4.90	3—5	5.60	3—5
28	Complete Manure for Potatoes and Root Crops,	9.75	3.30	4.12—4.94	3.97	2.05	3.04	9.06	6—8	6.02	5—6	8.76	8—10
32	Stockbridge Complete Manure for Potatoes and Vegetables,	10.34	3.31	3.25—4.25	4.95	3.15	4.08	12.18	8—10	8.10	7—8	6.97	5—6
34, 147	Fish and Potash (D Brand),	21.40	2.58	2.47—3.30	2.81	3.43	1.33	7.57	7.5—8.5	6.24	-	1.84	2—3
36	Complete Potato Manure,	8.69	3.70	3.30	3.45	2.10	1.84	7.39	-	5.55	5.75	9.25	10
42	Animal Fertilizer,	10.67	2.25	2.47—3.30	6.04	1.76	8.17	15.97	16—18	7.80	11—13	3.69	2.5—3.5
65	Complete Animal Fertilizer,	4.44	5.78	3.30—4.12	.95	6.57	5.17	12.69	16—18	7.52	-	7.12	7—8
76, 98	English Lawn Dressing,	8.20	4.78	4.95—5.78	1.28	3.66	2.30	7.24	6—8	4.94	5—7	2.86	2.5—3.5*

77, 141	Bay State Fertilizer, ...	14.80	2.42	2.47—3.30	6.72	4.16	1.94	12.82	10—14	10.88	9—12	2.28		2—3*		
80	Lawrence Fertilizer, ...	12.94	2.63	2.06—2.26	7.16	2.11	1.48	10.75	10—12	9.27	–	2.70		2—3		
82	Animal Fertilizer, ...	12.92	2.99	3—4.5	3.48	3.73	1.87	9.08	10—12	7.21	6—8	5.83		4—5		
86, 153, 199	Special Potato Manure, ...	15.12	3.37	3.71—4.57	6.60	1.92	.84	9.36	8—9	8.52	8—9.5	5.51		5.4—6.4*		
90, 157	Ammoniated Bone Superphosphate, . .	13.47	2.92	2.8—3.7	6.81	2.60	1.59	11.00	10—12	9.41	10—12	1.08		1—2*		
												Mechanical Analysis.				
	Bones.											Fine.	Med. Fine.	Med.	Coarse Med.	
24	Fine-ground Bone, ...	9.15	2.90	2.50—3.50	.20	7.90	12.57	20.67	22—24	8.10	–	16.64	23.43	49.73	10.20	
83, 154	Ground Bone Meal, ...	13.15	1.21	2—3	.32	10.49	17.00	27.81	25—28	10.81	–	17.57	47.70	25.47	9.26	
124	Ground Bone, ...	13.80	3.52	2.5—2.8	.51	8.19	12.54	21.24	25—27	8.70	–	17.86	19.86	18.56	43.72	
127, 215	Fine-ground Bone, ...	7.61	2.78	2.50	.26	8.44	16.50	25.20	25.56	8.70	–	38.43	32.95	19.17	9.45	
128	Pure Bone Meal, ...	4.84	1.75	2.00	.38	10.11	19.57	30.06	29.21	10.49	9.40	74.15	19.04	6.81	–	

* Sulphate of potash, the source of potash.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at—
	Compound Fertilizers.		
91	Quinnipiac Phosphate,	Quinnipiac Fertilizer Company, Boston, Mass.,	Fitchburg.
96	Cumberland Superphosphate,	Cumberland Bone Company, Portland, Me.,	Lowell.
105	Manure for Light Soils,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Fitchburg.
111	Alkaline Bone,	E. Frank Coe, New York, N. Y.,	Mansfield.
112	Cleveland Superphosphate,	Cleveland Dryer Company, Boston, Mass.,	So. Framingham.
118	Eclipse Phosphate,	Bradley Fertilizer Company, Boston, Mass.,	Palmer.
119	Potato Fertilizer,	J. J. H. Gregory & Son, Marblehead, Mass.,	Amherst.
123	Market Garden Manure,	Quinnipiac Fertilizer Company, Boston, Mass,	Fall River.
130	Complete Corn Manure,	H. J. Baker & Bro., New York, N. Y.,	Fall River.
131	Good Brand Excelsior Guano,	E. Frank Coe, New York, N. Y.,	Dighton.
136	Potato and Root Crop Manure,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Fall River.
138	Fish and Potash,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
140	Nitrogenous Superphosphate,	J. C. Dow & Co., Boston, Mass.,	Dighton.
166	High-grade Tobacco Manure,	Bradley Fertilizer Company, Boston, Mass.,	Greenfield.
169	Standard Phosphate,	Read Fertilizer Company, Syracuse, N. Y.,	Pittsfield.
173	Ammoniated Bone Superphosphate,	Preston's Fertilizer Company, Greenpoint, L. I.,	Williamstown.
184	Dry Ground Fish,	Bradley Fertilizer Company, Boston, Mass.,	Greenfield.

185	Fine Wrapper Tobacco Grower,	Williams & Clark Fertilizer Company, Boston, Mass.,	Greenfield.
190	Standard Potato and Tobacco Fertilizer,	Standard Fertilizer Company, Boston, Mass.,	Greenfield.
193	Tobacco Starter,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Greenfield.
195	High-grade Special,	Williams & Clark Fertilizer Company, Boston, Mass.,	Greenfield.
205	Fish and Potash,	National Fertilizer Company, Bridgeport, Conn.,	Hadley.
214	Tobacco Fertilizer,	National Fertilizer Company, Bridgeport, Conn.,	Hadley.
216	Potato, Onion and Tobacco Fertilizer,	Leander Wilcox, Mystic, Conn.,	Amherst.
217	Ammoniated Bone Superphosphate,	Leander Wilcox, Mystic, Conn.,	Amherst.
223	Tobacco Starter,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	South Deerfield.
224	Havana Tobacco Fertilizer,	Quinnipiac Fertilizer Company, Boston, Mass.,	South Deerfield.
234	Tobacco Fertilizer,	Clark's Cove Fertilizer Company, Boston, Mass.,	Agawam.

4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
91	Quinnipiac Phosphate,	14.41	2.56	2.47—3.30	7.14	2.21	1.45	10.80	10—14	9.35	9—12	2.32	2—3*
96	Cumberland Superphosphate,	16.43	2.79	2.06—2.88	6.22	2.91	2.43	11.56	10—12	9.13	8—10	2.01	2—3*
105	Manure for Light Soils,	10.70	4.90	4.04—6.59	5.19	2.77	2.29	10.25	8—10	7.96	6—8	7.38	6—8
111	Alkaline Bone,	11.13	1.03	1—1.5	7.42	.58	2.84	10.84	9—12	8.00	7—9	2.59	1.62—2.16*
112	Cleveland Superphosphate,	17.77	2.09	2.05—2.85	7.16	2.05	1.51	10.72	11—14	9.21	9—11	3.31	2—3*
118	Eclipse Phosphate,	13.60	2.54	1—2	3.27	6.40	1.49	11.16	12—15	9.67	10—12	2.84	1.5—2.5*
119	Potato Fertilizer,	7.65	4.09	4.12—4.94	2.70	2.42	2.30	7.42	7	5.12	5—6	12.70	13*
123	Market Garden Manure,	12.48	3.08	3.30—4.12	5.28	2.80	.90	8.98	9—13	8.08	8—11	7.13	7—8*
130	Complete Corn Manure,	11.31	3.98	3.71	8.43	2.84	1.89	8.16	-	6.27	5	7.10	7.5
131	Gold Brand Excelsior Guano,	8.92	2.23	2.5—3.5	6.60	2.00	2.56	11.16	9—13	8.60	8—11	8.21	6—8*
136	Potato and Root Crop Manure,	12.00	2.61	3—4	4.71	3.45	5.12	13.28	10—12	8.16	6—8	6.72	7—8
138	Fish and Potash,	28.81	3.64	3.71	2.17	2.66	.90	5.73	5—7	4.83	-	5.26	5—6
140	Nitrogenous Superphosphate,	16.69	3.11	2.06—2.88	5.76	3.32	1.28	10.36	-	9.08	8—10	3.35	1.80—2.52
166	Bradley's High grade Tobacco Manure,	6.18	5.81	5.77—6.59	1.84	2.41	1.71	5.96	4—5	4.25	-	14.08	10.80—12.42*

169	Standard Phosphate,	14.17	1.06	.82—1.65	3.10	6.65	.23	9.98	10—12	9.75	8—10	4.17	4—6*
173	Ammoniated Bone Superphosphate,	9.20	3.65	2.47—3.30	1.56	4.58	1.89	8.03	8—11	6.14	-	3.09	2—3
184	Dry Ground Fish,	15.63	8.33	7.41—9.06	1.28	2.95	2.04	6.27	7—9	4.23	-	-	-
185	Fine Wrapper Tobacco Grower,	6.30	5.84	5.77—6.59	1.41	2.82	2.81	7.04	6—9	4.23	5—7	9.96	10—12
190	Standard Potato and Tobacco Fertilizer,	13.86	1.83	2.05—2.88	7.01	1.33	2.42	10.76	9—13	8.34	-	3.69	3—4
193 223	Tobacco Starter,	10.35	2.85	2.47—3.30	6.42	2.46	4.22	13.10	12—16	8.88	-	3.90	2.5—3.5
195	High-grade Special,	12.45	3.66	3.71—4.11	7.09	.94	.59	8.62	8—11	8.03	7—9	7.83	7—9
205	Fish and Potash,	7.48	2.91	3.30—4.12	2.15	2.00	3.63	7.78	6—8	4.15	-	5.64	5—6
214	Tobacco Fertilizer,	11.32	4.53	3.30—4.94	7.65	1.14	.60	9.39	10—12	8.79	8—10	5.07	5.40—6.48*
216	Potato, Onion and Tobacco Manure,	14.44	3.35	3.25—4.25	4.86	2.20	1.79	8.85	8—9	7.06	7—8	6.72	6—7
217	Ammoniated Bone Superphosphate,	15.53	2.87	2.5—3.5	3.74	2.43	1.74	7.91	7—8	6.17	6—7	5.72	5—6
224	Havana Tobacco Fertilizer,	6.10	6.16	5.77—6.59	1.70	2.27	2.49	6.46	6—9	3.97	5—7	6.68	10—12*
234	Tobacco Fertilizer,	5.60	6.38	5.77—6.59	1.41	2.94	3.45	7.80	-	4.35	5—7	10.37	10—12

* Sulphate of potash, the source of potash

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at—
	Compound Fertilizers.		
3	Banner Fertilizer,	Walker, Stratman & Co., Pittsburg, Pa.,	Amherst.
5	Connecticut Wrapper Fertilizer, "Pinney Formula,"	Cleveland Linseed Oil Company, Cleveland, Ohio,	Amherst.
29	Tankage,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
45	Vegetable Manure,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Worcester.
46	Complete Manure for Potatoes and Vegetables,	Bradley Fertilizer Company, Boston, Mass.,	Worcester.
48	Potato Manure,	J. G. Jefferds, Worcester, Mass.,	Worcester.
62	Breck's Lawn and Garden Dressing,	Bradley Fertilizer Company, Boston, Mass.,	Boston.
72	Fruit and Vine Manure,	Mapes Formula and Peruvian Guano Company, New York, N. Y,	Boston.
75	West Andover Market Bone Phosphate,	J. E. McGovern, West Andover, Mass.,	Lawrence.
85	Tobacco and Potato Fertilizer,	Clark's Cove Fertilizer Company, Boston, Mass.,	Lawrence.
87	Lawn Dressing,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Fitchburg.
94	Sure Crop Bone Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Amesbury.
97	Cumberland Potato Fertilizer,	Cumberland Bone Phosphate Company, Portland, Me.,	Lowell.
101	Corn Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	Fitchburg.
103	Farm and Garden Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Fitchburg.
109	Fertilizer for Grass and Grain,	Great Eastern Fertilizer Company, Rutland, Vt.,	Mansfield.
117	Ammoniated Bone Superphosphate,	E. Frank Coe, New York, N. Y.,	Palmer.

145	Ammoniated Bone Superphosphate,	E. Frank Coe, New York, N. Y.,	Dighton.
152	Lawn Dressing,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
160	West Andover Market Bone Phosphate,	J. E. McGovern, West Andover, Mass.,	Amherst.
198	Ammoniated Bone Superphosphate,	E. Frank Coe, New York, N. Y.,	Williamstown.
207	Banner Fertilizer,	Walker, Stratman & Co., Pittsburg, Pa.,	Leeds.
222	Connecticut Wrapper Fertilizer, "Pinney Formula,"	Cleveland Linseed Oil Company, Cleveland, Ohio,	Amherst.
	Bones.		
26	Pure Raw Ground Bone,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
67	Fine-ground Bone,	Bradley Fertilizer Company, Boston, Mass.,	Boston.
70	Pure Fine-ground Bone,	C. A. Bartlett, Worcester, Mass.,	Boston.
88	Fine-ground Bone,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Newburyport.
113	Fine-ground Bone,	Bradley Fertilizer Company, Boston, Mass.,	Palmer.
126	Meat and Bone,	Thomas Hersom & Co., New Bedford, Mass.,	New Bedford.
146	White Oak Pure Ground Bone,	Clark's Cove Fertilizer Company, Boston, Mass.,	Dighton.
170	Quinnipiac Pure Ground Bone,	Quinnipiac Fertilizer Company, Boston, Mass.,	Williamstown.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
3, 207	Banner Fertilizer,	11.39	1.62	2.06—2.88	5.88	2.81	4.61	13.30	11—12	8.69	9—10	1.06	1—2
5, 222	Connecticut Wrapper Fertilizer, "Pinney Formula,"	6.53	4.22	4.50—5.25	–	3.84	1.74	5.58	5.70—6.20	3.84	–	11.20	10 -11*
29	Tankage,	8.78	5.99	6.18—6.59	–	5.64	6.52	12.16	10—11	5.64	–	–	–
45	Vegetable Manure,	10.78	4.57	4.94—6.59	5.62	2.56	1.62	9.80	8—10	8.18	6—8	7.40	6—8
46	Complete Manure for Potatoes and Vegetables,	12.17	3.47	3.73—4.52	6.70	2.00	.82	9.52	9—13	8.70	8—11	6.23	6—7
48	Potato Manure,	12.70	2.00	2.47—3.30	5.17	3.76	6.32	15.35	15 –17	8.93	10—12	4.98	5—6
62	Breck's Lawn and Garden Dressing,	9.55	3.95	4.12—4.94	3.86	2.07	2.05	7.98	–	5.93	5—6	5.47	5—6
72	Fruit and Vine Manure,	8.46	2.42	1.65—2.47	5.73	2.46	1.48	9.67	7—9	8.19	5—7	12.02	11—12
75, 160	West Andover Market Bone Phosphate,	14.92	2.10	1.50—2.50	4.22	9.64	1.74	15.60	13—15	13.86	–	3.92	2—4
85	Tobacco and Potato Fertilizer,	14.19	2.01	2.06—2.88	6.60	3.22	1.54	11.36	9—13	9.82	8—11	3.67	3—4*
87, 152	Crocker's Lawn Dressing,	8.53	3.18	4.12—4.94	.27	9.16	13.87	23.30	18—20	9.43	–	3.45	3.24—4.32*

94	Sure Crop Bone Phosphate,	13.55	.95	.82—1.65	7.96	2.76	3.07	13.79	10—12	10.72	5—6	2.09	1—2*		
97	Cumberland Potato Fertilizer,	15.67	2.34	2.06—2.88	6.91	3.58	1.79	12.28	11—13	10.49	9—11	3.55	3—4*		
101	Corn Manure,	12.73	2.28	2.06—2.88	6.90	3.46	2.12	12.48	10—14	10.36	9—12	1.64	1.50—2.50*		
103	Farm and Garden Phosphate,	11.11	2.51	1.65—2.47	6.45	1.74	3.48	11.67	12—14	8.19	8—10	2.39	2—3*		
109	Fertilizer for Grass and Grain,	15.91	3.48	2.88—3.71	5.98	2.36	1.48	9.82	-	8.34	8—12	2.20	2—4		
117, 145, 198	Ammoniated Bone Superphosphate,	10.40	1.88	2	7.43	1.24	3.07	11.74	11—15	8.67	9—12	1.75	1.85*		
												Mechanical Analysis.			
	Bones.											Fine.	Med. Fine.	Med.	Coarse Med.
26	Pure Raw Ground Bone,	10.07	3.61	3.30—3.71	-	7.58	15.86	23.44	22—26	7.58	-	13.46	41.23	3.68	1.63
67, 113	Fine-ground Bone,	9.21	3.79	2.50—3.25	.18	5.86	13.44	19.48	21—23	6.04	-	40.14	37.42	22.44	-
70	Pure Fine-ground Bone,	3.55	2.63	3—4	.51	9.98	15.61	26.10	24—26	10.49	-	55.85	27.73	16.00	.42
88	Fine-ground Bone,	9.06	2.61	3.50—4.50	.15	9.49	14.05	23.79	22—25	9.64	-	73.02	18.62	8.36	-
126	Meat and Bone,	5.48	4.47	4.24	-	6.93	12.96	19.89	19.52	6.93	6.73	-	-	-	-
146	White Oak Pure Ground Bone,	9.57	3.19	2.47—4.12	-	6.85	13.02	19.87	20—22	6.43	-	44.22	29.25	25.79	.74
170	Pure Ground Bone,	9.31	3.22	2.47—4.12	.26	7.02	12.54	19.82	20—25	7.28	-	51.94	26.49	21.57	-

* Sulphate of potash, the source of potash.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
2	Tobacco Special,	Walker, Stratman & Co , Pittsburg, Pa.,	Amherst.
89	Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Fitchburg.
120	General Combination Fertilizer,	J. J. H. Gregory & Son, Marblehead, Mass.,	Amherst.
133	Special Potato Manure,	Pacific Guano Company, Boston, Mass.,	Fall River.
135	Tobacco and Sulphur Lawn Fertilizer,	F. C. Sturtevant, Hartford, Conn.,	Brockton.
139	Bristol Fish and Potash,	Bowker Fertilizer Company, Boston, Mass.,	Dighton.
142	Great Planet "A" Manure,	Clark's Cove Fertilizer Company, Boston, Mass ,	Dighton.
149	Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
163	Ground Bone Fertilizer,	John C. Dow & Co., Boston, Mass.,	Amherst.
167	Ammoniated Bone Superphosphate,	National Fertilizer Company, Bridgeport, Conn.,	Pittsfield.
168	Tobacco and Sulphur Lawn Fertilizer,	F. C. Sturtevant, Hartford, Conn.,	Great Barrington.
172	Complete Grass Fertilizer,	National Fertilizer Company, Bridgeport, Conn.,	Pittsfield.
177	Ammoniated Bone Superphosphate,	National Fertilizer Company, Bridgeport, Conn.,	Great Barrington.
203	Special Tobacco Manure,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
209	Ground Bone and Potash,	E. Frank Coe, New York, N. Y.,	Hadley.

219	Dry Ground Fish Guano,	Leander Wilcox, Mystic, Conn.,	Amherst.
231	Tobacco Special,	Walker, Stratman & Co., Pittsburg, Pa.,	Northampton.
	Chemicals.		
8	Sulphate of Potash,	Williams & Clark Fertilizer Company, Boston, Mass.,	Hadley.
41	Muriate of Potash,	Bradley Fertilizer Company, Boston, Mass.,	Worcester.
51	Dissolved Bone-black,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
54	Sulphate of Potash,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
134	Muriate of Potash,	Clark's Cove Fertilizer Company, Boston, Mass.,	Dighton.
183	Sulphate of Potash,	Lucien Sanderson, New Haven, Conn.,	Greenfield.
232	Sulphate of Potash,	Clark's Cove Fertilizer Company, Boston, Mass.,	Agawam.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
2, 231	Tobacco Special,	10.50	3.46	2.47—3.30	5.42	.60	6.26	12.28	10—12	6.02	8—10	3.22	3—4
89, 149	Vegetable Bone Superphosphate,	11.90	5.03	5—6	5.08	.88	1.66	7.62	6—7	5.96	6.00—7.00	7.76	6—8*
120	General Combination Fertilizer,	7.51	3.14	3.29—4.12	1.84	3.17	2.97	7.98	8	5.01	6—7	12.17	12—13
133	Special Potato Manure,	18.84	2.78	2.47—3.30	4.91	1.82	2.05	8.78	7—10	6.73	5—7	5.10	5—6
135, 168	Tobacco and Sulphur Lawn Fertilizer,	13.23	1.95	1.96	–	–	–	.83	.75	–	–	8.11	7.66
139	Bristol Fish and Potash,	12.55	2.05	1.60—2.50	6.38	1.62	4.12	12.12	8—10	8.00	5—8	2.60	2—3*
142	Great Planet "A" Manure,	11.65	3.88	3.30—4.12	4.61	3.24	1.41	9.26	9—13	7.85	8—11	7.26	7—8*
163	Ground Bone Fertilizer,	7.91	2.32	2.06—2.47	.83	2.44	16.35	19.62	18—22	3.27	–	2.07	1.62—1.89*
167, 177	Ammoniated Bone Superphosphate,	7.42	1.90	1.65—2.47	1.75	4.67	5.14	11.56	9—11	6.42	7—9	3.88	2—4
172	Complete Grass Fertilizer,	13.27	4.25	4.12—4.94	7.32	2.15	.61	10.08	6—8	9.47	4—6	6.42	5—7

203	Special Tobacco Manure,	6.71	4.54	4.53—5.36	3.38	1.22	1.23	5.83	–	4.60	–	11.25	10—12*
209	Ground Bone and Potash,	9.71	1.57	2—2.50	.72	6.06	8.57	15.35	10.99-11.91	6.78	–	2.71	2.75*
219	Dry Ground Fish Guano,	8.51	8.52	8—10	.59	3.45	3.51	7.55	–	6.96	4—6	–	–
	Chemicals.												
8	Sulphate of Potash,	2.00	–	–	–	–	–	–	–*	–	–	29.10	–
41	Muriate of Potash,	1.57	–	–	–	–	–	–	–	–	–	51.40	48—55
51	Dissolved Bone-black,	15.72	–	–	12.95	2.22	.19	15.36	15.35	15.17	15.29	–	–
54	Sulphate of Potash,	6.00	–	–	–	–	–	–	–	–	–	26.52	25.93—28.10
134	Muriate of Potash,	1.75	–	–	–	–	–	–	–	–	–	48.90	–
183	Sulphate of Potash,	6.10	–	–	–	–	–	–	–	–	–	29.30	27.02—29.72
232	Sulphate of Potash,	.14	–	–	–	–	–	–	–	–	–	51.00	48.65—51.35

* Sulphate of potash, the source of potash.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at—
	Compound Fertilizers.		
4	Four-fold Fertilizer,	Walker, Stratman & Co., Pittsburg, Pa.,	Amherst.
15	Potato Manure,	Bradley Fertilizer Company, Boston, Mass.,	Springfield.
20	Potato Manure,	Bradley Fertilizer Company, Boston, Mass.,	Worcester.
23	Complete Manure for Top-dressing Grass,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
31	Superphosphate,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
33	A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
37	Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
60	Fish and Potash,	Bradley Fertilizer Company, Boston, Mass.,	North Amherst.
66	Hill and Drill Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Boston.
78	Royal Bone Phosphate,	Williams & Clark Fertilizer Company, Boston, Mass.,	Lowell.
79	Prolific Crop Producer,	Williams & Clark Fertilizer Company, Boston, Mass.,	Lowell.
84	Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Lawrence.
95	Farmers' New Method Fertilizer,	Bradley Fertilizer Company, Boston, Mass.,	Amesbury.
116	Hill and Drill Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	So. Framingham.
208	Four-fold Fertilizer,	Walker, Stratman & Co., Pittsburg, Pa.,	Leeds.
	Chemicals.		
6	Nitrate of Soda,	Williams & Clark Fertilizer Company, Boston, Mass.,	Hadley.
7	Dissolved Bone-black,	Williams & Clark Fertilizer Company, Boston, Mass.,	Hadley.

25	Nitrate of Soda,	Bradley Fertilizer Company, Boston, Mass.,	Worcester.
30	Nitrate of Soda,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
38	Muriate of Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
39	Dissolved Bone-black,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
44	Sulphate of Potash,	Bradley Fertilizer Company, Boston, Mass.,	Worcester.
58	Nitrate of Soda,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
59	Muriate of Potash,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
137	Nitrate of Soda,	Clark's Cove Fertilizer Company, Boston, Mass.,	Dighton.
180	Nitrate of Soda,	Quinnipiac Fertilizer Company, Boston, Mass.,	Williamstown.
181	Dissolved Bone-black,	Lucien Sanderson, New Haven, Conn.,	Greenfield.
182	Nitrate of Soda,	Lucien Sanderson, New Haven, Conn.,	Greenfield.
194	Sulphate of Potash,	Quinnipiac Fertilizer Company, Boston, Mass.,	Williamstown.
196	Muriate of Potash,	Lucien Sanderson, New Haven, Conn.,	Greenfield.
211	Sulphate of Potash,	National Fertilizer Company, Bridgeport, Conn.,	Hadley.
233	Sulphate of Potash,	Clark's Cove Fertilizer Company, Boston, Mass.,	Agawam.
	Bones.		
63	Fresh Ground Bone,	Bowker Fertilizer Company, Boston, Mass.,	Boston.
104	Pure Ground Bone,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Fitchburg.
107	Pure Ground Bone,	John C. Dow & Co., Boston, Mass.,	Lowell.
114	Fresh Ground Bone,	Bowker Fertilizer Company, Boston, Mass.,	So. Framingham.
161	Pure Ground Bone,	John C. Dow & Co., Boston, Mass.,	Amherst.

4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
4, 208	Four-fold Fertilizer,	10.88	1.65	1.65—2.47	4.55	2.98	4.27	11.80	10—11	7.53	8—9	4.32	2—3
15, 20	Potato Manure,	13.10	2.55	2.50—3.25	4.06	2.67	1.94	8.67	8—11	6.73	6—8	4.93	5—6
23	Complete Manure for Top-dressing Grass,	6.60	4.48	4.62—4.94	.76	3.35	1.77	5.88	7—8	4.11	4—5	8.04	8—10
31	Superphosphate,	16.06	2.32	2.47—3.30	4.96	3.81	3.20	11.97	10—12	8.77	8—10	3.01	3—4
33	A. A. Ammoniated Superphosphate,	13.77	2.72	2.47—3.30	7.69	2.13	.84	10.66	10.25—14.5	9.82	10—12	2.79	2—3
37, 84	Lawn and Garden Dressing,	9.33	4.10	4—5	5.84	1.82	4.46	12.12	6—8	7.66	5—6	7.68	5—6
60	Fish and Potash,	22.04	2.38	2.48—3.50	2.50	3.28	1.51	7.29	7.5—8.5	5.78	6—8	2.67	2—3
66, 116	Hill and Drill Phosphate,	12	2.95	2.5—3.25	6.52	3.96	2.56	13.04	11—15	10.48	10—13	2.65	2—3
78	Royal Bone Phosphate,	19.26	.95	1.03—1.65	5.25	3.12	2.15	10.52	8—11	8.37	7—9	2.48	2—3*
79	Prolific Crop Producer,	18.73	1.02	.82—1.64	5.01	3.21	2.17	10.39	7—11	8.22	6—9	2.73	1—2
95	Farmers' New Method Fertilizer,	16.85	1.18	1—2	5.42	2.61	1.69	9.72	10—13	8.03	8—10	2.29	2.16—2.70*
	Chemicals.												
6	Nitrate of Soda,	1.30	16.17	-	-	-	-	-	-	-	-	-	-

7	Dissolved Bone-black,	15.66	-	-	10.54	1.76	.44	12.74	-	12.30	-	-	-				
25	Nitrate of Soda,	1.12	16.04	14.83—16.48	-	-	-	-	-	-	-	-	-				
30	Nitrate of Soda,	.92	16.12	15.81—16.14	-	-	-	-	-	-	-	-	-				
38	Muriate of Potash,	.02	-	-	-	-	-	-	-	-	-	54.10	53.70—56.86				
39	Dissolved Bone-black,	16.25	-	-	15.42	.68	.18	16.28	17—18	16.10	-	-	-				
44	Sulphate of Potash,	.55	-	-	-	-	-	-	-	-	-	49.70	48—52				
58	Nitrate of Soda,	1.75	16.05	15.65—16.14	-	-	-	-	-	-	-	-	-				
59	Muriate of Potash,	.12	-	-	-	-	-	-	-	-	-	52.20	50.54—53.70				
137	Nitrate of Soda,	.85	16.03	15.66	-	-	-	-	-	-	-	-	-				
180	Nitrate of Soda,	1.55	15.85	14.87—16.06	-	-	-	-	-	-	-	-	-				
181	Dissolved Bone-black,	14.00	-	-	15.86	.43	2.43	18.72	16—18	16.29	-	-	-				
182	Nitrate of Soda,	2.37	16.11	14.90—16.48	-	-	-	-	-	-	-	-	-				
194	Sulphate of Potash,	1.35	-	-	-	-	-	-	-	-	-	49.40	-				
196	Muriate of Potash,	1.19	-	-	-	-	-	-	-	-	-	52.05	50.54—53.70				
211	Sulphate of Potash,	1.45	-	-	-	-	-	-	-	-	-	46.30	-				
233	Sulphate of Potash,	3.01	-	-	-	-	-	-	-	-	-	25.50	25.93—28.10				
	Bones.													Mechanical Analysis.			
														Fine.	Med. Fine.	Med.	Coarse Med.
63 / 114	Fresh Ground Bone,	5.98	3.23	2.47—3.30	2.89	13.07	2.97	18.83	18—22	15.96	5—7			33.10	31.39	26.27	9.24
104	Pure Ground Bone,	8.57	3.87	3.5—4.5	-	3.42	22.08	25.50	24—26	3.42	-			.53	29.46	55.37	14.64
107 / 161	Pure Ground Bone,	3.43	1.79	1.65—2.47	.20	16.82	10.69	27.71	24—26	17.02	-			58.24	38.06	3.70	-

* Sulphate of potash, the source of potash.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
99	Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Fitchburg.
115	Potato Phosphate,	Cleveland Dryer Company, Boston, Mass.,	So. Framingham.
121	Corn Fertilizer,	J. J. H. Gregory & Son, Marblehead, Mass.,	Amherst.
132	Dry Ground Menhaden Fish Guano,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
143	High-grade Special,	Williams & Clark Fertilizer Company, Boston, Mass.,	Dighton.
144	Fish and Potash,	Clark's Cove Fertilizer Company, Boston, Mass.,	Dighton.
151	Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
156	Ammoniated Practical Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
158	New Rival Ammoniated Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
164	Canada Hardwood Unleached Ashes,	Allison, Stroup & Co., Boston, Mass.,	Williamstown.
175	New England Favorite,	J. S. Reese & Co., Baltimore, Md.,	Pittsfield.
176	Fish and Potash,	Williams & Clark Fertilizer Company, Boston, Mass.,	Greenfield.
178	Grass Fertilizer,	Quinnipiac Fertilizer Company, Boston, Mass.,	Pittsfield.
179	Complete Fertilizer for Potatoes,	National Fertilizer Company, Bridgeport, Conn.,	Pittsfield.
186	Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	North Adams.
187	Bay State Fertilizer (G. G. Brand),	Clark's Cove Fertilizer Company, Boston, Mass.,	Greenfield.

189	Grass Fertilizer,	Quinnipiac Fertilizer Company, Boston, Mass.,	Williamstown.
191	Standard Fertilizer,	Standard Fertilizer Company, Boston, Mass.,	Great Barrington.
192	Lawn Dressing,	Williams & Clark Fertilizer Company, Boston, Mass.,	North Adams.
197	Blood, Meat and Bone,	Lucien Sanderson, New Haven, Conn.,	Greenfield.
200	Superphosphate No. 2,	Preston Fertilizer Company, Greenpoint, L. I.,	Williamstown.
202	Fine Dry Ground Fish,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
204	Complete Grass Manure,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
206	Dry Ground Fish,	National Fertilizer Company, Bridgeport, Conn.,	Hadley.
210	Excelsior Tobacco Grower,	E. Frank Coe, New York, N. Y.,	Hadley.
212	High-grade Fish Guano and Potash,	E. Frank Coe, New York, N. Y.,	Hadley.
213	Dry Ground Fish,	National Fertilizer Company, Bridgeport, Conn.,	Hadley.
220	Fish and Potash,	Leander Wilcox, Mystic, Conn.,	Amherst.
221	Corn Phosphate,	Williams & Clark Fertilizer Company, Boston, Mass.,	Amherst.
235	Potato Special,	J. S. Reese & Co., Baltimore, Md.,	Chicopee.
236	Whittemore's Complete Manure,	Whittemore Bros., Wayland, Mass.,	Amherst.

4. Analyses of Licensed Fertilizers, etc. — *Concluded.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
99, 151, 186	Wheat and Corn Phosphate,	14.61	1.78	2—3	7.32	2.50	2.05	11.87	11—15	9.82	10—13	1.82	1.6—2.7*
115	Potato Phosphate,	16.68	2.23	2—2.25	7.22	1.91	1.69	10.82	9—13	9.13	8—10	3.81	3—4*
121	Corn Fertilizer,	6.85	3.12	3.09	1.25	4.71	2.41	8.37	7	5.96	5.5	12.96	15
132	Dry Ground Menhaden Fish Guano,	9.77	8.86	8.24—9.89	.56	3.23	3.17	6.96	6.87—9.16	3.79	-	-	-
143	High-grade Special,	11.26	3.68	3.30—4.12	7.60	1.22	.90	9.72	8—11	8.82	7—9	7.90	7—9
144	Fish and Potash,	21.96	2.65	2.47—4.12	2.97	2.58	1.82	7.37	7—9	5.55	6—8	2.61	3—5*
156	Ammoniated Practical Superphosphate,	12.31	1.14	.82—1.64	5.95	.62	2.38	8.94	8—10	6.57	8—10	1.31	1—2
158	New Rival Ammoniated Superphosphate,	16.18	1.43	1.20—2	7.42	2.18	1.66	11.26	10—12	9.60	10—12	1.58	1.60—3
164	Canada Hardwood Unleached Ashes,	8.88	-	-	-	-	-	1.79	1.36—1.83	-	-	8.26	5.84—6.80
175	New England Favorite,	18.97	2.45	2.47—3.30	4.78	4.24	1.54	10.56	11—14	9.02	9—12	2.04	2—3
176	Fish and Potash,	22.34	2.10	2.06—2.88	2.64	3.27	1.02	6.93	6—9	5.91	4—6	4.61	4—6*
178, 189	Grass Fertilizer,	9.81	4.26	3.91—4.74	2.25	3.73	2.00	7.98	6—8	5.98	5—7	3.25	2—3*

179	Complete Fertilizer for Potatoes,	12.93	4.60	3.30—4.12	7.12	2.64	.30	10.06	10—12	9.76	8—10	5.44	6—8
187	Bay State Fertilizer (G. G. Brand),	13.58	2.09	1.85—2.68	6.45	2.05	1.92	10.44	10—13	8.50	8.5—11	2.13	2—3*
191	Standard Fertilizer,	15.46	2.00	2—3	6.60	2.99	1.54	11.13	10—15	9.59	8—12	2.27	2—3
192	Lawn Dressing,	8.78	4.31	4.95—5.78	1.90	3.60	1.28	6.78	6—8	5.50	5—7	3.36	2.5—3.5
197	Blood, Meat and Bone,	6.30	5.54	5.77—7.41	.38	3.58	5.12	9.08	10.12	3.96	-	-	-
200	Superphosphate No. 2,	15.33	1.71	.82—1.65	7.70	1.80	1.02	10.52	-	9.50	10—12	2.23	1—2
202	Fine Dry Ground Fish,	15.96	8.32	8—10	.51	4.09	1.51	6.14	7—8	4.60	-	-	-
204	Complete Grass Manure,	11.00	3.60	3.71	2.41	3.99	1.33	7.73	-	6.40	3	7.69	7
206, 213	Dry Ground Fish,	16.77	8.17	8.24—9.89	.40	5.34	1.76	7.50	6—8	5.74	-	-	-
210	Excelsior Tobacco Grower,	7.84	3.10	3—4	8.75	1.53	1.64	11.92	8—11	10.28	8—11	4.93	5—6*
212	High-grade Fish Guano and Potash,	10.78	2.73	3.30—4.10	2.46	4.20	3.08	9.74	7—11	6.66	6—9	2.92	2.75*
220	Fish and Potash,	13.15	3.44	3.25—4.25	2.38	2.71	1.46	6.55	6—7	5.09	5—6	4.45	4—5
221	Corn Phosphate,	14.52	2.52	2.06—2.88	7.16	4.38	2.22	13.76	10.25—14	11.54	9—12	1.62	1.5—2.5
235	Potato Special,	14.11	2.72	2.88—3.71	7.78	1.95	.20	9.93	-	9.73	6—8	7.65	7.5—9.5
236	Whittemore's Complete Manure,	11.69	3.30	2.47—3.30	6.24	5.86	1.84	13.94	12—14	12.10	8.12	4.30	3—4

* Sulphate of potash, the source of potash.

5. Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination.

Wood Ashes.

[I., sent on from Marblehead, Mass.; II., sent on from Westminster, Mass.; III., sent on from South Sudbury, Mass.; IV., sent on from South Deerfield, Mass.; V., sent on from Concord, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C,	18.06	6.51	4.80	4.67	15.40
Potassium oxide,	4.17	5.27	3.42	2.12	7.73
Calcium oxide,	24.68	38.92	43.40	49.36	34.27
Phosphoric acid,	.79	1.23	1.71	.61	1.13
Insoluble matter (before calcination),	27.66	21.09	10.51	5.63	12.45
Insoluble matter (after calcination),	25.06	19.32	9.02	4.04	11.11

Wood Ashes.

[I. and II., sent on from Concord, Mass.; III., sent on from Rock Bottom, Mass.; IV. and V., sent on from Sunderland, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	11.39	7.87	19.85	11.15	16.17
Potassium oxide,	8.39	5.56	3.66	5.83	5.94
Calcium oxide,	33.05	37.93	–*	–*	–*
Phosphoric acid,	1.74	.74	.95	1.83	Trace
Insoluble matter (before calcination),	16.11	19.02	16.89	23.85	31.13
Insoluble matter (after calcination),	14.27	17.64	13.24	18.17	20.02

* Not determined.

Wood Ashes.

[I. and II., sent on from Lowell, Mass.; III. and IV., sent on from Boston, Mass.; V., sent on from Amherst, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	7.30	3.39	16.59	9.51	24.63
Potassium oxide,	4.97	5.52	6.45	5.72	7.63
Phosphoric acid,	.46	2.41	.77	.56	.82
Insoluble matter (after calcination),	17.98	15.72	6.02	13.25	.46

5. ANALYSES, ETC. — *Continued.*

Wood Ashes.

[I , sent on from Tewksbury, Mass.; II. and III., sent on from Concord, Mass.; IV. and V., sent on from North Amherst, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	11.30	15.01	8.49	18.13	14.25
Potassium oxide,	6.80	8.05	7.10	5.05	5.95
Phosphoric acid,	1.69	.67	.31	.92	1.43
Insoluble matter (before calcination),	16.56	18.38	16.97	15.33	15.03
Insoluble matter (after calcination),	13.66	15.84	15.25	13.46	12.75

Wood Ashes.

[I., sent on from Winchendon, Mass.; II., sent on from North Hadley, Mass.; III., sent on from Concord, Mass.; IV., sent on from Framingham, Mass.; V., sent on from North Sudbury, Mass.]

	PER CENT.				
	I	II.	III.	IV.	V.
Moisture at 100° C.,	23.07	4.48	16.16	16.39	17.74
Potassium oxide,	2.87	6.75	5.88	4.83	6.45
Calcium oxide,	33.04	37.32	32.46	35.52	33.76
Phosphoric acid,	1.48	1.82	1.07	1.33	1.00
Insoluble matter (before calcination),	10.96	15.53	15.34	10.07	13.37
Insoluble matter (after calcination),	9.29	13.72	13.09	9.28	12.13

Wood Ashes.

[I. and II., sent on from Concord, Mass.; III., sent on from Eastham, Mass ; IV., sent on from Westborough, Mass.; V., sent on from Sunderland, Mass]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	8.96	13.00	15.33	20.57	19.52
Potassium oxide,	3.00	8.74	5.96	5.93	6.21
Calcium oxide,	25.60	36.44	36.14	32.03	29.51
Phosphoric acid,	.97	1.79	.26	1.48	1.83
Insoluble matter (before calcination),	36.93	8.44	12.91	10.05	13.47
Insoluble matter (after calcination),	34.89	6.40	10.38	8.09	10.85

5. ANALYSES, ETC. — *Continued.*

Wood Ashes.

[I. and II., sent on from Waltham, Mass.; III., sent on from Westminster, Mass.; IV. and V., sent on from Montague, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	8.97	23.75	3.13	16.53	26.80
Potassium oxide,	6.86	4.68	4.73	4.24	4.00
Phosphoric acid,	1.56	.90	1.33	1.15	1.20
Insoluble matter (after calcination),	17.07	17.43	22.03	15.73	13.55

Wood Ashes.

[I. and II., sent on from Concord, Mass.; III., sent on from North Amherst, Mass.; IV., sent on from Hadley, Mass.; V., sent on from Sudbury, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	20.98	9.39	17.35	13.43	11.48
Potassium oxide,	3.23	7.64	7.07	5.76	4.10
Calcium oxide,	46.44	39.00	35.51	–*	–*
Phosphoric acid,	1.02	1.69	1.64	1.54	1.66
Insoluble matter (before calcination),	15.73	15.44	8.60	–*	–*
Insoluble matter (after calcination),	14.10	13.95	6.30	10.23	15.33

Wood Ashes.

[I. and II., sent on from North Amherst, Mass.; III, sent on from Westborough, Mass.; IV., sent on from Acton, Mass.; V., sent on from South Framingham, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	8.21	11.28	5.50	23.49	6.58
Potassium oxide,	5.99	6.81	6.93	3.56	4.79
Calcium oxide,	39.48	40.24	45.20	–*	–*
Phosphoric acid,	1.13	1.28	1.41	1.25	1.02
Insoluble matter (before calcination),	10.33	10.58	10.57	11.02	–*
Insoluble matter (after calcination),	9.15	9.33	8.57	9.11	12.49

* Not determined.

5. ANALYSES, ETC. — *Continued.*

Wood Ashes.

[I. and II., sent on from South Sudbury, Mass.; III. and IV., sent on from Concord, Mass.; V., sent on from Acton, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	10.61	20.80	10.85	17.09	21.30
Potassium oxide,	5.24	4.19	4.33	5.00	4.00
Phosphoric acid,	1.20	.67	3.75	1.05	1.13
Insoluble matter (before calcination),	29.60	25.39	12.00	18.42	8.97

Wood Ashes.

[I. and II., sent on from Southampton, Mass.; III. and IV., sent on from Concord, Mass.; V., sent on from Sunderland, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	6.72	16.75	13.00	22.21	37.56
Potassium oxide,	5.72	4.58	9.46	4.40	1.51
Calcium oxide,	–*	–*	35.88	34.24	–*
Phosphoric acid,	.38	1.51	1.13	.56	.67
Insoluble matter (before calcination),	–*	–*	8.72	16.15	–*
Insoluble matter (after calcination),	7.22	26.37	6.90	13.65	10.38

Wood Ashes.

[I. and II., sent on from Concord, Mass.; III., sent on from East Whately, Mass.; IV., sent on from West Northfield, Mass.; V., sent on from Sunderland, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	19.43	14.04	11.06	5.04	21.83
Potassium oxide,	4.55	6.57	4.81	6.35	6.12
Calcium oxide,	35.48	34.55	–*	–*	–*
Phosphoric acid,	.81	1.60	.82	1.54	1.74
Insoluble matter (before calcination),	17.58	13.50	–*	–*	–*
Insoluble matter (after calcination),	14.79	11.28	5.76	13.55	11.78

* Not determined.

5. Analyses, etc. — *Continued.*

Wood Ashes.

[I. and II., sent on from Concord, Mass.; III., sent on from Hadley, Mass.; IV., sent on from Sunderland, Mass.; V., sent on from West Northfield, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	14.16	16.19	10.44	15.79	10.44
Potassium oxide,	5.78	6.36	6.38	6.86	5.46
Calcium oxide,	32.47	34.16	–*	–*	–*
Phosphoric acid,	1.61	1.00	1.28	.95	.05
Insoluble matter (before calcination),	15.46	14.35	–*	–*	–*
Insoluble matter (after calcination),	13.06	12.27	23.08	18.17	25.08

* Not determined.

Wood Ashes.

[I. and II., sent on from West Northfield, Mass; III., sent on from Amherst, Mass.; IV., sent on from Boston, Mass.; V., sent on from Pelham, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	10.92	5.36	9.52	8.11	11.22
Potassium oxide,	5.07	7.00	4.31	4.88	4.95
Phosphoric acid,	1.07	1.97	1.23	1.31	1.64
Insoluble matter (after calcination),	21.19	18.65	14.35	16.18	15.21

Wood Ashes.

[I. and II, sent on from Concord, Mass.; III., sent on from Danvers, Mass.; IV., sent on from Amherst, Mass.; V., sent on from Westborough, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	16.38	9.90	10.49	16.18	15.33
Potassium oxide,	6.55	7.44	5.57	3.39	6.25
Phosphoric acid,	.51	1.71	1.07	1.28	1.20
Insoluble matter (after calcination),	10.16	16.79	11.25	15.36	9.07

5. Analyses, etc. — *Continued.*

Wood Ashes.

[I. and II., sent on from Concord, Mass.; III., sent on from Hudson, Mass.; IV., sent on from Hingham, Mass.; V., sent on from Granby, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	4.87	11.22	17.70	2.37	11.07
Potassium oxide,	4.82	4.10	4.13	4.79	4.40
Calcium oxide,	37.00	32.60	33.20	32.80	42.80
Phosphoric acid,	1.40	1.28	1.28	1.16	1.80
Insoluble matter (after calcination),	22.81	18.06	14.31	30.38	13.91

Wood Ashes.

[I. and II., sent on from North Amherst, Mass.; III., sent on from South Deerfield, Mass.; IV., sent on from Concord, Mass.; V., sent on from South Sudbury, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	.30	1.65	3.60	7.35	29.48
Potassium oxide,	5.30	9.22	5.56	4.74	2.38
Calcium oxide,	–*	–*	41.97	42.40	37.71
Phosphoric acid,	3.08	1.54	.77	1.66	1.08
Insoluble matter (after calcination),	5.12	10.90	21.23	16.78	3.75

Wood Ashes.

[I., sent on from Amherst, Mass.; II. and III., sent on from Hadley, Mass.; IV., sent on from North Amherst, Mass.; V., sent on from West Northfield, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	13.57	16.85	30.38	18.05	9.19
Potassium oxide,	7.63	5.88	4.48	4.04	5.70
Calcium oxide,	32.51	36.42	26.55	–*	36.00
Phosphoric acid,	1.45	1.51	1.22	1.15	1.41
Insoluble matter (after calcination),	32.57	4.46	11.01	11.41	12.58

* Not determined.

5. ANALYSES, ETC. — *Continued.*

Wood Ashes.

[I., sent on from Marlborough, Mass.; II., sent on from Amherst, Mass.; III., IV. and V., sent on from Marblehead, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C., . .	2.98	4.21	20.97	12.72	11.30
Potassium oxide, . . .	4.98	3.82	5.12	5.48	4.60
Calcium oxide, . . .	37.26	31.14	31.80	37.00	40.40
Phosphoric acid, . . .	1.15	2.98	.70	1.22	1.79
Insoluble matter, . . .	25.25	18.97	14.73	15.12	10.60

Wood Ashes.

[I., sent on from Hudson, Mass.; II., sent on from Hingham, Mass.; III. and IV., sent on from Granby, Mass.; V., sent on from Amesbury, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C., . .	17.70	2.37	11.07	1.17	10.41
Potassium oxide, . . .	4.13	4.79	4.40	4.31	4.33
Calcium oxide, . . .	33.20	32.80	42.80	25.60	32.67
Phosphoric acid, . . .	1.28	1.16	1.80	1.54	.90
Insoluble matter, . . .	14.31	30.38	13.91	39.49	16.65

Wood Ashes.

[I., sent on from Merrimac, Mass.; II. and III., sent on from Boston, Mass.; IV., sent on from Clinton, Mass.; V., sent on from Fall River, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C., . .	10.67	5.18	9.81	25.28	9.78
Potassium oxide, . . .	5.74	5.93	4.90	3.72	4.71
Calcium oxide, . . .	38.60	39.40	44.40	–*	–*
Phosphoric acid, . . .	1.28	.96	1.66	1.25	1.51
Insoluble matter, . . .	11.75	6.97	1.40	12.38	18.52

* Not determined.

5. ANALYSES, ETC. — *Continued.*

Cotton-hull Ashes.

[I. and II , sent on from Boston, Mass.; III., sent on from Amherst, Mass.; IV., sent on from Agawam, Mass.]

	PER CENT.			
	I.	II.	III.	IV.
Moisture at 100° C.,	9.87	7.77	14.78	13.92
Potassium oxide,	24.06	20.40	23.96	24.12
Phosphoric acid,	7.68	7.83	7.93	9.21
Insoluble matter,	15.38	11.78	10.10	9.33

Ashes from Cremation of Swill.

[Sent on from Lowell, Mass.]

	PER CENT.			
	I.	II.	III.	IV.
Moisture at 100° C.,	.51	.07	.04	.11
Potassium oxide,	1.73	8.83	7.03	1.25
Calcium oxide,	24.79	28.18	33.74	47.60
Magnesium oxide,	1.87	—*	—*	—*
Ferric and aluminic oxides,	3.57	7.63	6.25	1.06
Phosphoric acid,	16.61	17.18	26.09	32.26
Insoluble matter (before calcination),	39.60	18.49	14.40	15.13
Insoluble matter (after calcination),	29.72	16.53	11.41	13.20

* Not determined.

Logwood Ashes.

[Sent on from Boston, Mass.]

	Per Cent.
Moisture at 100° C.,	.55
Potassium oxide,	.26
Calcium oxide,	58.26
Magnesium oxide,	1.46
Ferric and aluminic oxides,	1.46
Phosphoric acid,	.70
Carbonic acid,	32.95
Insoluble matter,	3.09

Sewage.

[Sent on from Danvers, Mass.]

	Per Cent.
Moisture at 100° C.,	99.959
Potassium oxide,	.0033
Phosphoric acid,	.0012
Nitrogen,	.0028

5. Analyses, etc. — *Continued.*

Peat.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	27.51
Nitrogen,	.12

Florida Muck.

[Sent on from Boston, Mass.]

	Per Cent.
Moisture at 100° C.,	5.94
Nitrogen,	1.07

Canal Mud.

[Sent on from North Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	60.93
Potassium oxide,	–
Phosphoric acid,	.28
Nitrogen,	.15
Insoluble matter,	32.67

Muck.

[I., sent on from Rockbottom, Mass.; II., sent on from Pansy Park, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	78.06	81.09
Nitrogen,	.43	.42

Horse Manure.

[Sent on from Westborough, Mass.]

	Per Cent.
Moisture at 100° C.,	11.25
Potassium oxide,	2.82
Phosphoric acid,	1.46
Nitrogen,	.74
Insoluble matter,	12.60

Boiler Soot.

[Sent on from Hatfield, Mass.]

	Per Cent.
Moisture at 100° C.,	18.80
Potassium oxide,	.54
Phosphoric acid,	1.60
Calcium oxide,	2.31
Magnesium oxide,	1.19
Insoluble matter,	58.91

5. ANALYSES, ETC. — *Continued.*

Castor Pomace.

[I., sent on from Amherst, Mass.; II., sent on from Hatfield, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	10.08	8.07
Potassium oxide,	3.40	–*
Phosphoric acid,	2.26	–*
Nitrogen,	5.60	5.22
Insoluble matter,	1.70	–*

* Not determined.

Muriate of Potash.

[I., sent on from North Amherst, Mass.; II., sent on from Amherst, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	1.98	.30
Potassium oxide,	52.00	36.00
Insoluble matter,	.26	.18

Saltpetre.

[Sent on from South Acton, Mass.]

	Per Cent.
Moisture at 100° C.,	.66
Potassium oxide,	45.74
Nitrogen,	11.88

Saltpetre Waste.

[Sent on from Townsend Harbor, Mass.]

	Per Cent.
Moisture at 100° C.,	1.90
Potassium oxide,	6.24
Sodium oxide,	43.01
Chlorine,	43.69
Nitrogen,	1.56

Sulphate of Soda.

[Sent on from Denver, Col.]

	Per Cent.
Moisture at 100° C.,	1.38
Water of combination,	.99
Sulphuric acid,	54.93
Insoluble matter,	.16

5. ANALYSES, ETC. — *Continued.*

Nitrate of Soda.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	1.82
Nitrogen,	14.72
Insoluble matter,	.12

Carbonate of Potash.

[Sent on from Amherst, Mass.]

	Per Cent.
Water of combination,	26.88
Potassium oxide,	18.48
Magnesium oxide,	19.52
Insoluble matter,	.39

Odorless Phosphate.

[I., sent on from Hatfield, Mass.; II., sent on from Marshfield, Mass.; III., sent on from Amherst, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	1.12	.60	.63
Potassium oxide,	.32	.52	–*
Phosphoric acid,	18.40	19.45	18.42
Calcium oxide,	49.00	61.30	48.27
Carbonic acid,	2.67	2.25	–
Insoluble matter,	7.20	5.12	5.53

Concentrated Phosphates.

[I., double superphosphate; II., phosphate of ammonia; III., phosphate of potash; sent on from New York, N. Y.]

	Per Cent		
	I.	II.	III
Moisture at 100° C.,	5.74	6.05	3.76
Potassium oxide,	–	–	32.56
Calcium oxide,	16.00	–	–
Total phosphoric acid,	47.80	43.86	35.70
Soluble phosphoric acid,	38.38	–*	–*
Reverted phosphoric acid,	9.04	–*	–*
Insoluble phosphoric acid,	.38	–*	–*
Nitrogen,	–	10.37	–
Insoluble matter,	.60	.82	.92

* Not determined.

5. ANALYSES, ETC. — *Continued.*

Florida Phosphates.

[Sent on from Amherst, Mass.]

	Per Cent. I.	Per Cent. II.
Moisture at 100° C.,	.95	2.52
Total phosphoric acid,	23.87	21.72
Soluble phosphoric acid,	.16	–*
Reverted phosphoric acid,	1.37	–*
Insoluble phosphoric acid,	22.34	–*
Insoluble matter,	31.77	30.50

South Carolina Floats.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	.83
Total phosphoric acid,	23.39
Soluble phosphoric acid,	Trace
Reverted phosphoric acid,	2.33
Insoluble phosphoric acid,	21.06
Insoluble matter,	20.16

Ground Bone.

[I., sent on from New Bedford, Mass.; II., sent on from Peabody, Mass.; III., sent on from Northborough, Mass.]

	Per Cent. I.	Per Cent. II.	Per Cent. III.
Moisture at 100° C.,	5.94	4.62	4.85
Total phosphoric acid,	25.33	25.68	22.96
Soluble phosphoric acid,	.32	.52	.29
Reverted phosphoric acid,	15.16	18.23	9.77
Insoluble phosphoric acid,	9.85	6.93	12.90
Nitrogen,	2.96	2.18	4.02
Insoluble matter,	1.02	–*	.70

* Not determined.

5. Analyses, etc. — *Continued.*

Ground Bone.

[Sent on from Concord, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	9.23	8.71	3.21
Total phosphoric acid,	21.80	20.29	23.46
Soluble phosphoric acid,	–	–	.47
Reverted phosphoric acid,	12.96	10.20	12.21
Insoluble phosphoric acid,	8.84	10.09	10.78
Nitrogen,	3.54	3.70	3.22

Cotton-seed Meal.

[I., II. and III., sent on from Amherst, Mass.; IV. and V., sent on from Hatfield, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	8.65	7.78	6.48	6.47	7.08
Potassium oxide,	2.25	1.78	2.50	–*	–*
Phosphoric acid,	3.17	3.15	2.58	–*	–*
Nitrogen,	6.50	6.24	6.88	7.23	6.62

* Not determined.

Mill Sweepings.

[Sent on from Westborough, Mass.]

	Per Cent.
Moisture at 100° C.,	9.49
Potassium oxide,	.66
Phosphoric acid,	1.18
Nitrogen,	3.76
Insoluble matter,	5.01

Home-mixed Fertilizers.

[I., animal meal and tankage; II., tankage and potash, sent on from Eastham, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	3.20	6.20
Potassium oxide,	–	6.75
Phosphoric acid,	19.71	15.35
Nitrogen,	4.48	3.93

5. Analyses, etc. — *Concluded.*

Animal Fertilizers.

[I., sent on from New Bedford, Mass.; II., sent on from Boston, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	4.69	12.87
Total phosphoric acid,	13.22	9.08
Soluble phosphoric acid,	.19	–*
Reverted phosphoric acid,	7.72	–*
Insoluble phosphoric acid,	5.31	–*
Nitrogen,	1.75	8.16
Insoluble matter,	11.92	–

* Not determined.

Complete Fertilizers.

[I., sent on from Cleveland, Ohio; II., sent on from South Sudbury, Mass.; III., sent on from Springfield, Mass.; IV., sent on from West Berlin, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.50	11.25	12.47	11.03
Total phosphoric acid,	6.13	11.83	14.14	12.77
Soluble phosphoric acid,	.32	2.30	1.85	7.52
Reverted phosphoric acid,	5.30	8.95	9.78	3.24
Insoluble phosphoric acid,	.51	.58	2.51	2.01
Potassium oxide,	6.68	2.44	7.22	1.40
Nitrogen,	4.53	4.69	4.11	2.39

Complete Fertilizers.

[I. and II., sent on from North Hadley, Mass.; III. and IV., sent on from Hudson, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	6.00	7.62	9.87	4.34
Total phosphoric acid,	8.60	9.77	12.54	11.16
Soluble phosphoric acid,	3.74	3.22	4.96	4.76
Reverted phosphoric acid,	2.51	3.58	4.30	3.38
Insoluble phosphoric acid,	2.35	2.97	3.28	3.02
Potassium oxide,	5.59	6.64	5.99	6.66
Nitrogen,	2.29	2.46	3.20	3.94

6. Miscellaneous Analyses.

Oriental Fertilizer and Bug Destroyer.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	87.14
Solid matter,	12.86
Arsenic oxide,	2.38
Potassium oxide,	3.50
Sodium oxide,	6.08
Nitrogen,	.67
Chlorine,	3.00
Sulphuric acid,	.64

Non-poisonous Potato-bug Destroyer.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	None
Nitrogen,	.08
Ash,	79.85
Potassium oxide,	None
Calcium oxide,	68.20
Magnesium oxide,	7.29
Ferric and aluminic oxides,	1.38
Phosphoric acid,	Trace
Insoluble matter (before calcination),	7.29
Insoluble matter (after calcination),	1.50

Clay (so called).

[Sent on from Lynn, Mass.]

	Per Cent.
Moisture at 100° C.,	.70
Calcium oxide,	54.35
Magnesium oxide,	1.04
Ferric and aluminic oxides,	2.80
Phosphoric acid,	Trace
Carbonic acid,	37.30
Organic and volatile matter,	40.65
Insoluble matter,	2.57

6. Miscellaneous Analyses — *Concluded.*

Soil.

[Sent on from Springfield, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	2.39	8.15
Potassium oxide,	.21	.15
Calcium oxide,	.56	.54
Phosphoric acid,	.18	.16
Nitrogen,	.154	.147

Wheat Flour.

[From station barn.]

	Per Cent.
Moisture at 100° C.,	14.46
Potassium oxide,	.179
Phosphoric acid,	.230
Nitrogen,	1.840

Buttermilk.

[Sent on from Shelburne, Mass.]

	Per Cent.
Moisture at 100° C.,	91.130
Nitrogen,	.510
Ash,	.810
Potassium oxide,	.046
Phosphoric acid,	.041
Calcium oxide,	.045

7. Miscellaneous Fodder Analyses.

[I., corn ensilage, sent on from Marlborough, Mass.; II., oat and pea ensilage, sent on from Marlborough, Mass.; III., corn ensilage, sent on from Amherst, Mass.; IV., ensilage of *Panicum miliaceum*, sent on from Amherst, Mass.; V., ensilage of *Panicum crus-galli*, sent on from Amherst, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	79.98	38.02	71.27	78.01	76.75
Dry matter,	20.02	61.98	28.73	21.99	23.25
	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.					
Crude ash,	5.50	9.19	6.05	8.32	8.57
" cellulose,	25.24	31.34	22.89	31.80	36.93
" fat,	3.20	3.94	4.86	3.34	2.74
" protein,	8.22	13.72	10.00	7.46	7.89
Nitrogen-free extract matter,	57.84	41.81	56.20	49.08	43.87
	100.00	100.00	100.00	100.00	100.00

[I., millet (*Panicum crus-galli*), sent on from Amherst, Mass.; II., soja bean (late), sent on from Amherst, Mass.; III., soja bean (early green), sent on from Amherst, Mass.; IV., soja bean (early white), sent on from Amherst, Mass.; V., soja bean (medium black), sent on from Amherst, Mass.]

	Per Cent.				
	I.	II.	III.	IV	V.
Moisture at 100° C.,	75.11	79.78	69.84	66.56	76.87
Dry matter,	24.89	20.22	30.16	33.44	23.13
	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.					
Crude ash,	9.75	21.33	12.97	15.25	12.66
" cellulose,	29.51	23.62	23.51	27.12	21.73
" fat,	2.79	2.25	3.87	2.77	6.76
" protein,	11.45	18.56	19.35	17.63	21.67
Nitrogen-free extract matter,	46.50	34.24	40.40	37.23	37.18
	100.00	100.00	100.00	100.00	100.00

7. Miscellaneous Fodder Analyses — *Continued.*

[I., soja-bean straw, sent on from Amherst, Mass.; II., Japanese radish (*merinia*), sent on from Amherst, Mass.; III., Japanese radish (*niyashige*), sent on from Amherst, Mass.; IV., soja-bean meal, sent on from Amherst, Mass.; V., cotton-seed hulls, sent on from Boston, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	13.97	93.26	92.58	10.80	8.15
Dry matter,	86.03	6.74	6.74	89.20	91.85
	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.					
Crude ash,	5.57	10.32	9.87	5.04	2.81
" cellulose,	46.51	10.27	9.79	5.01	46.60
" fat,	1.17	1.05	.96	18.17	1.79
" protein,	5.73	7.47	6.51	41.18	4.10
Nitrogen-free extract matter,	41.02	70.89	72.87	30.60	44.70
	100.00	100.00	100.00	100.00	100.00

[I., ground oats, sent on from Baldwinville, Mass.; II., wheat bran, sent on from Amherst, Mass.; III., dried brewers' grain, sent on from Boston, Mass.; IV., new-process linseed meal, sent on from North Amherst, Mass.; V., cotton-seed meal, sent on from Amherst, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	9.71	9.85	7.99	10.19	6.48
Dry matter,	90.29	90.15	92.01	89.81	93.52
	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.					
Crude ash,	3.93	7.11	–*	–*	7.16
" cellulose,	9.29	11.82	–*	–*	5.60
" fat,	3.51	5.30	6.04	2.89	11.04
" protein,	13.20	18.17	18.74	38.84	46.08
Nitrogen-free extract matter,	70.07	57.60	–*	–*	30.12
	100.00	100.00	–	–	100.00

* Not determined.

7. Miscellaneous Fodder Analyses — *Continued.*

[I., Richardson glucose feed, sent on from Amherst, Mass.; II., glucose refuse, sent on from Boston, Mass.; III., starch feed (Pope), sent on from Amherst, Mass.; IV., rye feed, sent on from North Dartmouth, Mass.; V., oat feed, sent on from Baldwinville, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	6.32	6.71	5.48	9.63	9.47
Dry matter,	93.68	93.29	94.52	90.37	90.53
	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.					
Crude ash,	1.13	1.20	.90	2.62	3.98
" cellulose,	5.00	4.77	15.21	3.52	8.06
" fat,	11.67	10.55	11.30	2.79	4.28
" protein,	23.12	21.06	11.28	13.56	15.60
Nitrogen-free extract matter,	59.08	62.42	61.31	77.51	69.08
	100.00	100.00	100.00	100.00	100.00

[I., proteina, sent on from North Amherst, Mass.; II., proteina, sent on from Weston, Mass.; III., proteina, sent on from Bolton, Mass.; IV., cooked feed (oats and corn), sent on from Worcester, Mass.; V., excelsior feed, sent on from Holden, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	8.04	6.80	8.63	5.55	7.08
Dry matter,	91.96	93.20	91.31	94.45	92.92
	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.					
Crude ash,	2.80	3.24	2.13	4.04	4.43
" cellulose,	12.33	10.18	–*	8.73	14.65
" fat,	7.74	8.24	8.53	5.34	5.42
" protein,	24.47	27.23	24.57	14.75	9.75
Nitrogen-free extract matter,	52.66	51.11	–*	67.14	65.75
	100.00	100.00	–	100.00	100.00

* Not determined.

7. Miscellaneous Fodder Analyses — *Continued.*

[I., gluten feed (Pope), sent on from Amherst, Mass.; II., gluten feed, sent on from Marlborough, Mass.; III. and IV., gluten feed, sent on from Amherst, Mass.; V., gluten feed, sent on from Sunderland, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	13.98	7.64	8.06	8.99	9.39
Dry matter,	86.02	92.36	91.94	91.01	90 61
	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.					
Crude ash,	.75	1.14	–*	–*	–*
" cellulose,	1.80	5.78	–*	–*	–*
" fat,	16.34	9.18	7.57	7.71	13.71
" protein,	38.68	21.11	27.19	27.33	27.45
Nitrogen-free extract matter,	42.43	62.79	–*	–*	–*
	100.00	100.00	–	–	–

[I., gluten meal, sent on from North Amherst, Mass.; II., gluten meal, sent on from Agawam, Mass.; III., gluten meal, sent on from Sunderland, Mass.; IV., gluten meal, sent on from South Acton, Mass.; V., gluten meal, sent on from Boston, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	6.93	5.93	6.85	7.29	6.15
Dry matter,	93.07	94.07	93.15	92.71	93.85
	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.					
Crude ash,	.69	.50	–*	–*	–*
" cellulose,	9.08	5.80	–*	–*	–*
" fat,	9.81	12.08	10.67	7.07	16.52
" protein,	14.51	30.63	25.43	32.56	29.47
Nitrogen-free extract matter,	65.91	50.99	–*	–*	–*
	100.00	100.00	–	–	–

* Not determined.

7. Miscellaneous Fodder Analyses — *Concluded.*

[I., pea bran, sent on from Great Barrington, Mass.; II., Louisiana rice bran, sent on from Sudbury, Mass.; III., bran, sent on from South Acton, Mass.; IV., oat meal and barley refuse, sent on from Amherst, Mass.; V., cranberries, sent on from Amherst, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	7.14	10.25	6.67	7.76	89.41
Dry matter,	92.86	89.75	93.33	92.24	10.59
	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.					
Crude ash,	3.33	10.59	–*	3.84	1.99
" cellulose,	46.16	14.86	–*	22.30	11.63
" fat,	1.16	9.66	5.04	3.80	5.61
" protein,	10.31	9.82	17.88	7.45	4.40
Nitrogen-free extract matter,	39.04	55.07	–*	62.61	76.37
	100.00	100.00	–	100.00	100.00

* Not determined.

II.

Analyses of Milk sent on for Examination.

[Per Cent.]

Number of Sample.	Solids.	Fat.	Solids not Fat.	Locality.	Remarks.
1, . .	11.77	3.03	8.74	Westborough.	
2, . .	12.29	3.37	8.92	Westborough.	
3, . .	12.83	3.61	9.22	Marblehead.	
4, . .	13.19	3.93	9.26	Marblehead.	
5, . .	12.24	3.38	8.86	Berlin.	
6, . .	13.30	4.62	8.68	Barre.	
7, . .	11.71	3.36	8.35	Furnace.	
8, . .	10.34	3.11	7.23	Northampton.	
9, . .	12.98	3.90	9.08	Barre Plains.	
10, . .	12.78	3.80	8.98	Barre Plains.	
11, . .	10.53	1.28	9.25	Barre Plains.	
12, . .	14.11	5.07	9.04	Barre Plains.	
13, . .	4.62	.28	3.43	Amherst.	Whey.
14, . .	6.32	–	–	Adams.	Whey.
15, . .	12.60	3.36	9.24	Westborough.	
16, . .	12.70	3.50	9.20	Gilbertville.	
17, . .	12.53	4.02	8.51	Furnace.	
18, . .	13.29	4.27	9.03	Barre Plains.	
19, . .	12.06	3.21	8.85	Granby.	
20, . .	9.24	.30	8.94	Granby.	Skim-milk
21, . .	12.50	3.81	8.69	Gilbertville.	
22, . .	13.07	4.31	8.76	Barre.	
23, . .	13.43	4.48	8.95	Barre Plains.	
24, . .	12.66	3.81	8.85	New Braintree.	
25, . .	11.68	1.80	9.80	Westborough.	
26, . .	11.76	2.05	9.71	Westborough.	

III.

Analyses of Water sent on for Examination.*

[Parts per million.]

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
1	.012	.140	2.00	108.00	50.00	1.11	-	Barre.
2	.052	.128	26.00	112.00	72.00	2.08	-	North Amherst.
3	.012	.072	3.00	88.00	56.00	-	-	Barre.
4	.248	.220	4.00	192.00	92.00	3.38	-	East Amherst.
5	.028	.084	6.00	104.00	48.00	3.25	-	Amherst.
6	.088	.144	4.00	170.00	82.00	2.34	None.	Littleton.
7	.008	.140	7.00	70.00	36.00	.79	-	Prescott.
8	.016	.092	6.00	116.00	60.00	2.34	None.	Littleton.
9	.012	.152	4.00	112.00	44.00	.63	None.	Littleton.
10	.052	.360	18.00	180.00	60.00	2.60	-	Upton.
11	.080	.160	8.00	100.00	40.00	2.08	-	Leverett.
12	.076	.316	15.00	330.00	130.00	6.86	-	Westminster.
13	Trace.	.340	15.00	740.00	316.00	46.60	-	Weston.
14	.012	.104	8.00	120.00	40.00	1.95	-	Weston.
15	.020	.180	14.00	120.00	36.00	2.73	-	Nichawong.
16	.048	.084	25.00	220.00	56.00	5.29	-	Globe Village.
17	1.660	.760	43.00	366.00	126.00	7.43	-	Globe Village.
18	.016	.080	34.00	310.00	100.00	6.43	-	Globe Village.
19	.028	.080	14.00	126.00	46.00	4.03	-	Framingham.
20	Trace.	.104	10.00	238.00	74.00	5.71	None.	Amherst.
21	.028	.092	6.00	120.00	56.00	4.57	-	Plainfield.
22	.184	.336	16.00	200.00	84.00	5.86	-	East Templeton.
23	.660	.268	34.00	310.00	70.00	10.75	-	Templeton.
24	.136	.192	76.00	220.00	100.00	11.50	-	Charlton Depot.
25	Trace.	.116	2.00	128.00	50.00	1.56	-	Chatham.
26	.568	.152	40.00	286.00	130.00	10.60	-	Amherst.

* Analysis of well water at the station is confined to chemical tests with reference to an excess of foreign matter from sinks, barns, etc.

ANALYSES OF WATER, ETC. — *Continued.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat	Hardness (Clark's Degree).	Lead.	Locality.
27	.776	.172	40.00	300.00	60.00	8.86	-	Concord.
28	.300	.240	224.00	956.00	200.00	10.90	-	Concord.
29	.160	.240	10.00	200.00	60.00	1.56	-	Concord.
30	.056	.108	6.00	-	-	1.43	-	Amherst.
31	.072	.100	26.00	220.00	100.00	5.43	-	Amherst.
32	.672	.308	98.00	640.00	200.00	9.43	-	Amherst.
33	.044	.096	50.00	360.00	100.00	10.00	-	Concord.
34	.116	.168	66.00	340.00	90.00	10.75	-	Concord.
35	.064	.248	36.00	240.00	80.00	4.71	-	Concord.
36	.100	.184	36.00	410.00	130.00	7.43	-	Concord.
37	.024	.176	12.00	140.00	56.00	4.29	-	South Acton.
38	Trace.	.092	8.00	256.00	80.00	7.43	None.	South Acton.
39	.240	.180	8.00	230.00	90.00	4.03	-	South Amherst.
40	None.	.060	4.00	200.00	52.00	4.29	-	Oakdale.
41	.040	.064	20.00	200.00	40.00	1.95	-	Amherst.
42	None.	.292	3.00	104.00	40.00	1.95	-	South Deerfield.
43	.020	.140	20.00	160.00	64.00	2.73	-	Concord.
44	.040	.124	6.00	120.00	72.00	1.95	-	Concord.
45	.052	.128	42.00	260.00	100.00	5.71	-	Concord.
46	.044	.136	15.00	160.00	92.00	2.21	-	Concord.
47	Trace.	.160	22.00	240.00	100.00	4.86	-	Barre.
48	.082	.324	20.00	286.00	58.00	4.86	-	Amherst.
49	.024	.186	17.00	250.00	80.00	4.43	-	Amherst.
50	.032	.086	13.00	140.00	28.00	1.69	-	Concord.
51	.372	.100	7.00	144.00	86.00	.48	-	North Andover.
52	.344	.326	8.00	128.00	52.00	1.11	-	North Andover.
53	.080	.184	15.00	236.00	100.00	4.03	-	Shirley.
54	.036	.266	4.00	96.00	54.00	-	-	Amherst.
55	.022	.256	-	62.00	36.00	-	-	Amherst.
56	.078	.160	6.00	64.00	14.00	-	-	Amherst.
57	.028	.120	24.00	224.00	120.00	5.14	-	Amherst
58	.100	.104	10.00	140.00	64.00	3.51	-	Westfield.
59	.028	.150	3.00	124.00	64.00	2.86	-	South Deerfield.
60	.016	.092	10.00	100.00	32.00	1.82	-	Weston.
61	.060	.132	11.00	112.00	44.00	2.60	-	Weston.

ANALYSES OF WATER, ETC. — *Concluded.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
62	.094	.190	22.00	236.00	140.00	4.71	-	Barre.
63	.072	.164	8.00	200.00	52.00	2.47	-	Wellesley Hills.
64	.204	.244	4.00	132.00	48.00	1.11	-	Petersham.
65	.052	.120	7.00	110.00	32.00	2.08	-	Chelmsford.
66	.032	.244	3.00	160.00	90.00	.79	-	North Brookfield.
67	.032	.084	14.00	152.00	42.00	1.95	None.	North Amherst.
68	3.200	1.300	35.00	260.00	44.00	6.00	-	South Deerfield.
69	Trace.	.136	6.00	84.00	28.00	1.95	-	Leverett.
70	.132	.100	6.00	96.00	56.00	.32	-	South Sudbury.
71	.084	.148	4.00	116.00	24.00	-	-	South Deerfield.
72	2.560	1.456	5.00	112.00	16.00	1.11	-	South Deerfield.
73	.016	.076	2.00	76.00	24.00	2.08	-	Concord.
74	.020	.096	4.00	60.00	24.00	.16	-	Amherst.
75	.272	.296	4.00	136.00	96.00	1.69	-	Littleton.
76	.040	.144	18.00	160.00	72.00	1.69	-	Littleton.
77	.272	.208	7.00	176.00	92.00	3.25	-	Littleton.
78	.040	.088	8.00	120.00	36.00	2.60	-	Littleton.
79	.036	.068	24.00	240.00	140.00	5.43	-	Littleton.
80	.240	.200	4.00	260.00	120.00	6.86	-	Littleton.
81	2.400	1.300	33.00	276.00	52.00	6.57	-	South Deerfield.
82	.032	.152	2.00	100.00	36.00	2.60	-	Holyoke.
83	.044	.068	2.00	104.00	40.00	4.86	-	Holyoke.
84	.036	.172	2.00	76.00	32.00	2.21	-	Holyoke.
85	.088	.096	3.00	164.00	20.00	7.43	-	Holyoke.
86	.020	.084	6.00	168.00	32.00	5.86	-	Framingham.
87	.012	.108	3.00	136.00	72.00	3.38	-	Chelmsford.
88	.028	.096	20.00	184.00	44.00	2.99	-	Westminster.
89	.020	.084	7.00	220.00	108.00	3.25	-	Littleton.
90	Trace.	.076	8.00	140.00	40.00	3.51	-	Littleton.
91	.064	.072	10.00	776.00	100.00	4.86	-	Framingham.
92	.020	.076	8.00	112.00	52.00	2.47	-	Westminster.
93	.040	.068	2.00	96.00	56.00	1.11	-	Westminster.

The analyses have been made according to Wancklyn's process, familiar to chemists, and are directed towards the

indication of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wancklyn and E. T. Chapman.)

Mr. Wancklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon* of chlorine (=71.4 parts per million), accompanied by more than .08 parts per million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight-hundredths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

5. Albuminoid ammonia, over .15 parts per million, ought to absolutely condemn a water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

An examination of the previously stated analyses indicates that Nos. 4, 10, 11, 12, 13, 15, 17, 22, 23, 24, 26, 27, 28, 29, 32, 34, 35, 36, 37, 39, 42, 48, 49, 51, 52, 53, 54, 55, 56, 62, 63, 64, 66, 68, 72, 75, 77, 80, 81, 82 and 84 ought to be condemned as unfit for family use; while Nos. 1, 2, 6, 7, 9, 31, 47, 58, 59, 61, 65, 69, 70, 71, 76 and 85 must be considered suspicious. From this record it will be seen that one-half of the entire number of well waters tried proved unfit for drinking. Heating waters to the boiling point not unfrequently removes immediate danger.

Parties sending on water for analysis ought to be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

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* One gallon equals 70,000 grains.

IV. Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.

Prepared by C. S. Crocker.

[As the basis of valuation changes from year to year, no valuation is stated.]

1868-1894.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the reports of the State Inspector of Fertilizers from 1873 to 1893, contained in the reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

	Analyses.	Moisture.	Ash.	Nitrogen. Maximum.	Nitrogen. Minimum.	Nitrogen. Average.	Potash. Maximum.	Potash. Minimum.	Potash. Average.	Total Phosphoric Acid. Maximum.	Total Phosphoric Acid. Minimum.	Total Phosphoric Acid. Average.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
I. Chemicals, Refuse, Salts, Ashes, etc.																							
Muriate of potash,	66	1.98	-	-	-	-	58.98	45.94	**51.05**	-	-	-	-	-	-	6.69	-	.55	-	-	-	48.80	.70
Sulphate of potash,	24	2.55	-	-	-	-	51.28	21.36	**34.99**	-	-	-	-	-	-	4.46	-	1.50	-	45.72	-	-	.75
Sulphate of potash magnesia,	16	4.96	-	-	-	-	29.48	16.96	**23.55**	-	-	-	-	-	-	6.25	2.57	-	-	44.25	-	2.60	1.41
Carbonate of potash,	1	26.88	-	-	-	-	-	-	**18.48**	-	-	-	-	-	-	-	-	19.52	-	-	-	-	.39
Phosphate of potash,	1	3.76	-	-	-	-	-	-	**32.56**	-	-	**37.50**	-	-	-	-	-	-	-	13.43	-	-	.92
Kainite,	4	3.20	-	-	-	-	16.48	12.51	**13.54**	-	-	-	-	-	-	18.97	1.15	9.80	-	20.25	-	33.25	2.13
Carnallite,	1	-	-	-	-	-	-	-	**13.68**	-	-	-	-	-	-	7.66	-	13.19	-	.56	-	41.56	-
Krugite,	1	4.82	-	-	-	-	-	-	**8.42**	-	-	-	-	-	-	5.27	12.45	8.79	-	31.94	-	6.63	14.96
Sulphate of magnesia (Kieserite),	9	22.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.82	17.30	-	36.10	-	-	5.73
Nitrate of potash,	4	1.30	-	14.58	11.60	**12.71**	45.62	44.76	**45.27**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate of soda,	25	1.47	-	16.01	14.28	**14.70**	-	-	-	-	-	-	-	-	-	35.50	-	-	-	-	-	.50	.50
Sulphate of ammonia,	26	1.05	-	21.68	19.59	**22.16**	-	-	-	-	-	-	-	-	-	-	-	-	-	60.00	-	-	-
Phosphate of ammonia,	1	6.05	-	-	-	**10.37**	-	-	-	-	-	**43.86**	-	-	-	-	-	-	-	12.46	-	-	.82
Sulphate of soda,	1	1.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59.43	-	-	-
Saltpetre waste,	12	2.54	-	3.30	.52	**2.22**	30.94	1.55	**13.66**	-	-	-	-	-	-	37.01	.75	.19	-	1.85	-	46.25	-

Nitre salt-cake,	2	6.03	-	-	-	2.29	-	-	.87	-	-	-	-	-	-	29.56	-	-	-	47.77	-	-	3.92
Wood ashes,	329	12.75	-	-	-	-	10.80	2.32	5.33	5.58	.05	1.59	-	-	-	-	33.73	3.31	.96	-	-	-	14.12
Cotton-seed-hull ashes,	40	8.15	-	-	-	-	42.12	9.91	22.48	13.67	2.89	8.40	-	-	-	-	9.33	10.47	1.71	-	-	-	13.32
Ashes of spent tan-bark,	5	4.84	-	-	-	-	2.87	.60	1.81	2.77	.13	1.36	-	-	-	-	31.11	3.39	1.78	-	-	-	25.21
Corn-cob ashes,	1	1.20	-	-	-	-	-	-	7.08	-	-	2.37	-	-	-	-	11.70	-	1.28	-	-	-	52.09
Railroad-tie ashes,	1	4.70	-	-	-	-	-	-	.92	-	-	.56	-	-	-	-	2.51	-	-	-	-	-	80.20
Peat ashes,	1	4.67	-	-	-	-	-	-	.46	-	-	.11	-	-	-	-	2.28	1.63	6.13	-	-	-	45.17
Logwood ashes,	2	1.10	-	-	-	-	.08	-	.04	.70	.11	.40	-	-	-	-	31.09	1.46	1.46	-	32.95	-	3.09
Hard-pine wood ashes,	1	.75	-	-	-	-	-	-	10.16	-	-	2.24	-	-	-	-	24.95	-	-	-	-	-	29.90
Mill ashes,	1	.53	-	-	-	-	-	-	1.60	-	-	.46	-	-	-	-	34.93	1.35	-	-	-	-	36.36
Swill ashes,	4	.18	-	-	-	-	8.83	1.25	4.71	32.36	16.61	23.06	-	-	-	-	33.58	1.87	4.65	-	-	-	17.74
Ashes from blue works,	1	12.14	63.78	-	-	-	-	-	9.02	-	-	-	-	-	-	-	-	-	-	-	-	-	12.30
Sea-weed ashes,	1	1.47	-	-	-	-	-	-	.92	-	-	.30	-	-	-	8.76	6.06	4.37	-	2.98	-	6.60	63.65
Gypsum,	3	13.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32.86	-	-	48.01	-	-	.59
Gypse,	1	1.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50.87	-	-	-	-	-	2.87
Nova Scotia plaster,	10	6.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33.85	.75	-	45.75	-	-	2.50
Onondaga plaster,	4	13.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.00	4.66	-	32.50	8.20	-	9.83
Lime,	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	96.10	-	-	-	-	-	1.33
Gas-house lime,	3	22.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.66	8.30	-	20.73	-	-	6.05
Lime waste from sugar factory,	1	36.30	-	-	-	-	-	-	.22	-	-	2.25	-	-	-	-	27.51	-	-	-	-	-	.32
Lime-kiln ashes,	11	15.90	-	-	-	-	2.12	.02	1.15	3.16	.36	1.02	-	-	-	-	42.17	2.60	-	-	17.75	-	7.87
Marls (Massachusetts),	7	13.70	-	-	-	-	-	-	.24	2.72	.06	1.05	-	-	-	-	40.50	.64	.69	-	28.57	-	3.44

	Analyses.	Moisture.	Ash.	Nitrogen. Maximum.	Nitrogen. Minimum.	Nitrogen. Average.	Potash. Maximum.	Potash. Minimum.	Potash. Average.	Total Phosphoric Acid. Maximum.	Total Phosphoric Acid. Minimum.	Total Phosphoric Acid. Average.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
I. Chemicals, Refuse, Salts, Ashes, etc. —Concluded.																							
Marls (Virginia),	2	15.98	-	-	-	-	.61	.37	.49	.09	.08	.09	-	-	-	-	7.25	.21	-	.66	7.25	-	64.23
Greens and marl (Virginia),	1	1.25	-	-	-	-	-	-	1.14	-	-	9.37	-	-	-	-	25.78	-	5.13	-	-	-	41.32
Olive earth (Virginia),	1	1.97	-	-	-	-	-	-	.24	-	-	13.73	-	-	-	-	19.16	-	6.00	-	-	-	50.55
Ammoniated marl,	1	3.31	-	-	-	1.61	-	-	-	-	-	10.39	-	.41	9.98	-	-	-	-	-	-	-	-
Marl (North Carolina),	1	1.50	-	-	-	-	-	-	.04	-	-	.56	-	-	-	-	21.95	.61	-	-	-	-	50.18
Clay (so called),	1	.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54.35	1.04	2.80	-	37.32	-	2.57
II. Guanos, Phosphates, etc.																							
Peruvian guano,	26	14.81	37.61	13.50	4.44	7.85	4.08	1.14	2.61	20.60	5.96	15.26	4.57	3.79	6.90	-	-	-	-	-	-	-	6.60
Bat guano from Texas,	9	40.09	18.24	10.51	2.58	6.47	-	-	1.31	6.53	1.00	3.76	-	-	-	-	-	-	-	-	-	-	2.00
Bat guano from Florida,	2	15.66	-	-	-	9.74	-	-	1.77	3.44	3.26	3.35	-	-	-	-	-	-	-	-	-	-	19.33
Rat guano from Florida,	1	10.32	-	-	-	3.32	-	-	6.85	-	-	2.30	-	-	-	-	-	-	-	-	-	-	1.15
Cuba guano,	5	24.27	-	2.74	.63	1.67	-	-	-	16.16	11.54	13.35	-	-	-	-	-	-	-	-	-	-	3.17
Caribbean guano (orchilla),	12	7.31	-	-	-	-	-	-	-	35.43	18.11	26.77	-	-	-	-	39.95	3.29	-	2.68	-	-	1.27
Mona Island guano,	1	13.32	-	-	-	.76	-	-	-	-	-	21.88	-	7.55	11.33	-	37.49	-	-	-	-	-	2.45

South Carolina rock phosphate,	6	1.45	-	-	-	-	-	-	-	30.51	24.70	**27.47**	.27	.07	27.13	-	41.87	3.03	4.80	-	-	-	9.04
South Carolina floats,	1	.83	-	-	-	-	-	-	-	-	-	**23.39**	-	2.33	21.06	-	-	-	-	-	-	-	20.16
Florida rock phosphate,	27	2.07	-	-	-	-	-	-	-	38.97	6.95	**26.78**	-	-	-	-	30.32	-	7.59	-	-	-	27.49
Soft Florida phosphate,	1	2.24	-	-	-	-	-	-	-	-	-	**17.71**	-	-	-	-	14.64	-	6.72	-	-	-	13.37
Navassa phosphate,	2	7.60	-	-	-	-	-	-	-	34.45	34.09	**34.27**	-	-	-	-	37.45	-	10.27	-	-	-	2.70
Brockville phosphate,	1	2.50	-	-	-	-	-	-	-	-	-	**35.21**	-	-	-	-	-	-	-	-	-	-	6.46
Phosphatic slag,	4	1.45	-	-	-	-	-	-	-	30.51	18.91	**23.49**	-	3.06	21.65	-	48.66	3.42	10.12	-	-	-	9.40
Odorless phosphate,	3	3.35	-	-	-	-	.52	.32	**.42**	19.45	18.40	**18.75**	-	-	-	-	52.85	-	-	-	2.51	-	5.90
Dissolved bone-black,	4	11.14	47.50	-	-	-	-	-	-	17.54	15.35	**16.04**	14.56	1.12	.36	-	-	-	-	-	-	-	3.46
Bone-black,	5	4.60	-	-	-	-	-	-	-	30.54	16.56	**28.28**	-	-	-	-	-	-	-	-	-	-	3.64
Double superphosphate,	1	5.74	-	-	-	-	-	-	-	-	-	**47.80**	38.38	9.04	.38	-	16.00	-	-	1.19	-	-	.60
South American bone-ash,	1	7.00	-	-	-	-	-	-	-	-	-	**35.89**	-	-	-	-	44.89	-	-	-	-	-	4.50
Acid phosphate,	1	14.23	69.95	-	-	-	-	-	-	-	-	**14.64**	10.34	2.42	1.88	-	-	-	-	-	-	-	10.81
III. Refuse Substances.																							
Dried blood,	16	12.23	6.37	13.55	8.10	**10.51**	-	-	-	6.23	1.53	**2.05**	-	-	-	-	-	-	-	-	-	-	-
Ammonite,	1	5.88	-	-	-	**11.33**	-	-	-	-	-	**3.43**	-	-	-	-	-	-	-	-	-	-	1.38
Oleomargarine refuse,	1	8.54	14.42	-	-	**12.12**	-	-	-	-	-	**.88**	-	-	-	-	-	-	-	-	-	-	.96
Felt refuse,	1	29.24	33.53	-	-	**5.26**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sponge refuse,	1	7.25	-	-	-	**2.43**	-	-	-	-	-	**3.19**	-	-	-	-	3.94	1.27	-	-	-	-	39.05
Horn shavings,	1	4.83	-	-	-	**15.31**	-	-	-	-	-	**.42**	-	-	-	-	-	-	-	-	-	-	-
Ivory dust,	1	11.50	52.63	-	-	**6.64**	-	-	-	-	-	**24.56**	.97	17.97	5.62	-	-	-	-	-	-	-	-

	Analyses.	Moisture.	Ash.	Nitrogen. Maximum.	Nitrogen. Minimum.	Nitrogen. Average.	Potash. Maximum.	Potash. Minimum.	Potash. Average.	Total Phosphoric Acid. Maximum.	Total Phosphoric Acid. Minimum.	Total Phosphoric Acid. Average.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
III. Refuse Substances—Continued.																							
Horn and hoof waste,	3	10.17	7.63	15.49	11.84	13.25	-	-	-	2.30	1.36	1.83	-	-	-	-	-	-	-	-	-	-	.24
Raw wool,	1	6.95	7.54	-	-	12.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.63
Wool waste,	8	14.26	24.10	10.20	1.05	5.27	3.08	.06	1.21	.67	.05	.35	-	-	-	-	.11	.06	.80	-	-	-	8.20
Wool washings (water),	1	-	-	-	-	-	-	-	3.92	-	-	-	-	-	-	.49	.28	-	-	-	-	-	-
Wool washings (acid),	1	-	-	-	-	-	-	-	4.20	-	-	-	-	-	-	.40	.61	.20	-	-	-	-	-
Wool washings (alkaline),	1	92.03	3.28	-	-	.09	-	-	1.09	-	-	-	-	-	-	.92	.04	-	-	-	-	-	.22
Meat mass,	3	12.09	13.60	11.50	9.69	10.44	-	-	-	3.58	.56	2.07	-	-	-	-	-	-	-	-	-	-	.58
Bone soup,	1	82.92	7.07	-	-	1.14	-	-	-	-	-	1.26	-	-	-	-	-	-	-	-	-	-	-
Dried soup from meat and bone,	1	14.80	8.40	-	-	9.97	-	-	-	-	-	.53	-	-	-	-	-	-	-	-	-	-	.64
Dried soup from rendering cattle feet,	1	10.80	7.50	-	-	14.47	-	-	-	-	-	.46	-	-	-	-	-	-	-	-	-	-	.26
Dried soup from horse rendering,	1	92.14	-	-	-	1.12	-	-	-	-	-	.14	-	-	-	-	-	-	-	-	-	-	-
Soap-grease refuse,	2	29.25	51.39	4.20	2.21	3.21	-	-	-	15.37	11.04	13.21	-	-	-	-	-	-	-	-	-	-	1.29
Bones,	148	6.94	56.03	4.70	1.57	3.96	-	-	-	32.52	15.16	22.24	.38	8.24	13.62	-	-	-	-	-	-	-	1.09
Meat and bone,	1	5.70	-	-	-	4.01	-	-	-	-	-	21.88	.26	8.32	13.30	-	-	-	-	-	-	-	-
Fish with less than twenty per cent. water,	62	12.56	21.50	11.40	6.81	7.32	-	-	-	11.26	5.50	8.25	.55	2.64	5.06	-	-	-	-	-	-	-	2.01

Fish with between twenty and forty per cent. water,	10	30.19	20.59	7.41	4.22	5.97	-	-	-	8.32	4.68	7.09	.74	2.69	3.64	-	-	-	-	-	-	-	1.68
Fish with more than forty per cent. water,	10	45.46	15.50	7.60	2.43	4.97	-	-	-	8.56	2.94	5.08	1.17	1.33	2.58	-	-	-	-	-	-	-	1.35
Whale meat, raw,	1	44.50	1.04	-	-	4.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lobster shells,	1	7.27	-	-	-	4.50	-	-	-	-	-	3.52	-	-	-	-	22.24	1.30	-	-	-	-	.27
Castor-bean pomace,	6	9.68	5.70	5.72	5.22	5.51	3.40	.64	1.57	2.26	1.57	2.18	-	-	-	-	.87	.29	-	-	-	-	1.75
Cotton-seed meal,	24	6.47	5.78	7.26	4.02	6.63	2.09	.48	1.69	3.36	.73	1.54	-	-	-	-	-	-	-	-	-	-	.33
Rotten brewers' grain,	1	78.77	-	-	-	.72	-	-	.04	-	-	.43	-	-	-	-	.26	.15	-	-	-	-	.59
Mill sweepings,	1	9.49	-	-	-	3.76	-	-	.66	-	-	1.18	-	-	-	-	-	-	-	-	-	-	5.01
Tobacco leaf,	1	13.05	21.01	-	-	2.75	-	-	7.24	-	-	.43	-	-	-	-	4.17	2.17	.32	-	-	-	4.17
Tobacco stems,	6	10.61	14.07	2.91	.90	2.29	8.82	3.76	6.44	2.09	.44	.60	-	-	-	.34	3.89	1.23	-	-	-	-	.82
Cotton waste, wet,	1	34.69	-	-	-	1.30	-	-	.80	-	-	1.54	-	-	-	-	2.45	1.13	-	-	-	-	41.33
Cotton waste, dry,	3	6.44	60.60	2.09	.96	1.50	1.62	.66	1.10	.84	.26	.52	-	-	-	-	-	-	-	-	-	-	45.00
Cotton dust,	1	34.46	50.93	-	-	.50	-	-	.19	-	-	.21	-	-	-	-	.90	.90	-	-	-	-	47.46
Glucose refuse,	1	8.10	-	-	-	2.62	-	-	.15	-	-	.29	-	-	-	-	.18	.02	-	-	-	-	.07
Waste from lactate factory,	1	34.11	-	-	-	.68	-	-	-	-	-	.67	-	-	-	-	22.59	-	-	-	-	-	6.92
Hop refuse,	1	8.98	-	-	-	.98	-	-	.11	-	-	.20	-	-	-	-	.27	.10	-	-	-	-	.63
Banana skins,	1	13.99	-	-	-	.24	-	-	5.46	-	-	1.80	-	-	-	-	-	-	-	-	-	-	-
Sumac waste,	1	63.06	6.80	-	-	1.19	-	-	3.25	-	-	-	-	-	-	-	1.14	3.25	-	-	-	-	2.25
Eel-grass,	2	35.39	15.60	.96	.70	.83	1.61	.21	.91	.41	.22	.32	-	-	-	1.63	2.13	.11	-	-	-	-	1.06
Pine-barren grass,	1	8.48	2.40	-	-	.16	-	-	.07	-	-	.18	-	-	-	-	-	-	-	-	-	-	1.67
Pine needles,	1	9.48	3.42	-	-	.46	-	-	.03	-	-	.12	-	-	-	-	-	-	-	-	-	-	1.22

	Analyses.	Moisture.	Ash.	Nitrogen. Maximum.	Nitrogen. Minimum.	Nitrogen. Average.	Potash. Maximum.	Potash. Minimum.	Potash. Average.	Total Phosphoric Acid. Maximum.	Total Phosphoric Acid. Minimum.	Total Phosphoric Acid. Average.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
III. Refuse Substances—Concluded.																							
Rockweed, green,	1	68.50	23.70	-	-	.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rockweed, dry,	1	10.68	35.75	-	-	1.45	-	-	4.89	-	-	2.75	-	-	-	7.90	7.66	.21	-	-	-	-	10.40
Jute waste,	1	13.10	-	-	-	1.50	-	-	.08	-	-	.72	-	-	-	-	-	-	-	-	-	-	-
Starch waste from rubber factory,	1	10.01	.23	-	-	.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sludge from sewage precipitating tanks,	1	88.49	9.50	-	-	.05	-	-	.05	-	-	.10	-	-	-	-	1.58	.39	6.22	-	-	-	.93
Sludge,	1	6.28	-	-	-	.68	-	-	-	-	-	1.36	-	-	-	-	8.66	-	17.68	-	-	-	38.03
Blue-green algæ (*Lyngbia majuscula*), dry,	1	16.26	-	-	-	4.25	-	-	.79	-	-	.19	-	-	-	3.53	2.06	1.18	-	-	-	-	5.53
Mussel mud, wet,	1	60.01	27.29	-	-	.21	-	-	6.17	-	-	.10	-	-	-	.70	.93	.14	3.48	-	-	-	-
Mussel mud, dry,	1	2.24	72.02	-	-	.72	-	-	-	-	-	.35	-	-	-	-	23.39	-	8.26	-	-	-	37.60
Salt mud,	2	53.37	41.19	.40	.39	.40	.33	.32	.33	-	-	-	-	-	-	.94	.91	.37	4.13	-	-	-	34.88
Fresh-water mud,	1	40.37	-	-	-	1.37	-	-	.22	-	-	.26	-	-	-	-	1.27	.29	1.80	-	-	-	18.26
Muck,	16	60.26	13.75	2.54	.26	.97	-	-	-	.17	.08	.13	-	-	-	-	-	-	-	-	-	-	11.35
Peat,	10	61.50	8.20	1.40	.41	.85	-	-	.18	-	-	.08	-	-	-	-	.52	.72	2.14	-	-	-	2.20
Peat,	1	10.73	17.26	-	-	1.73	-	-	.06	-	-	.03	-	-	-	-	-	-	-	-	-	-	10.14
Turf,	2	19.29	6.36	1.97	1.91	1.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Soot,	3	1.88	77.10	.21	.09	.15	1.83	.21	.76	1.54	.19	.87	-	-	-	-	3.11	-	7.19	-	-	-	67.25
Boiler soot,	1	18.80	-	-	-	-	-	-	.26	-	-	.70	-	-	-	-	58.28	1.46	1.46	-	32.95	-	3.09
IV. Animal Excrement, etc.																							
Barn-yard manure,	56	66.49	-	1.366	.21	.54	1.40	.13	.53	.75	.10	.41	-	-	-	-	.30	.19	-	-	-	-	8.48
Horse manure,	1	11.24	-	-	-	.74	-	-	2.82	-	-	1.46	-	-	-	-	-	-	-	-	-	-	12.60
Sheep manure,	1	64.88	-	-	-	.686	-	-	.525	-	-	.425	-	-	-	-	-	-	-	-	-	-	.404
Drainage from a manure heap,	1	93.20	3.66	-	-	.98	-	-	.88	-	-	.24	-	-	-	-	-	-	-	-	-	-	-
Poudrette, dry,	1	5.25	35.45	-	-	3.58	-	-	.49	-	-	5.74	-	-	-	-	-	-	-	-	-	-	4.65
Hen manure, fre ,	2	52.35	24.75	1.20	.79	.99	.32	.18	.25	1.00	.47	.74	-	-	-	-	1.19	.89	-	1.24	-	-	23.50
Hen manure, dry,	1	8.35	-	-	-	2.13	-	-	9.94	-	-	2.02	-	-	-	-	2.22	.62	-	-	-	-	34.64

V. Compilation of Analyses of Fodder Articles, Fruits, Sugar-producing Plants, Dairy Products, etc.,

MADE AT

AMHERST, MASS.

1868-1894.

Prepared by C. S. Crocker.

A. Analyses of Fodder Articles.

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients.

C. Analyses of Fruit.

D. Analyses of Sugar-producing Plants.

E. Dairy Products.

F. Insecticides.

A. *Analyses of Fodder Articles.*

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain —													
					PROTEIN.			FAT.			NITROGEN-FREE EXTRACT.			FIBRE.			Ash.
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	
I. Green Fodders.																	
Fodder corn,	31	31.47	10.33	**20.29**	17.19	6.05	**9.86**	6.10	1.42	**2.44**	63.13	42.02	**56.51**	31.53	18.27	**25.29**	5.90
Fodder corn ensilage,	38	37.43	13.12	**21.70**	16.72	5.98	**8.66**	6.49	1.82	**3.80**	65.69	42.99	**54.28**	38.92	17.67	**27.73**	5.53
Corn and soja-bean ensilage,	3	28.97	19.67	**23.55**	15.27	7.91	**10.53**	5.35	3.02	**4.04**	52.24	40.50	**43.47**	37.84	26 62	**31.15**	10.81
Oat and pea ensilage,	1	–	–	**61.98**	–	–	**13.72**	–	–	**3.94**	–	–	**41.81**	–	–	**31.34**	9.19
Ensilage of *Panicum miliaceum*,	1	–	–	**21.99**	–	–	**7.46**	–	–	**3.34**	–	–	**49.08**	–	–	**31.80**	8.32
Ensilage of *Panicum crus-galli*,	1	–	–	**23.25**	–	–	**7.89**	–	–	**2.74**	–	–	**43.87**	–	–	**36.93**	8.57
Sorghum,	6	23.18	12.38	**17.41**	11.84	7.46	**8.74**	2.00	1.21	**1.55**	64.93	47.65	**56.15**	29.27	22.00	**26.73**	6.83
Common millet,	9	42.29	21.32	**35.42**	12.16	5.43	**7.50**	3.99	2.09	**2.74**	58.61	46.39	**53.93**	33.98	24.88	**30.99**	4.84
Japanese millet (white head),	3	26.24	20.95	**24.76**	10.98	7.26	**8.72**	2.64	1.94	**2.33**	50.87	46.71	**49.60**	38.90	30.12	**34.47**	4.88
Japanese millet (red head),	6	33.83	22.66	**27.33**	7.99	4.92	**6.90**	2.45	1.58	**2.01**	60.83	50.11	**52.91**	35.29	25.21	**32.10**	6.08
Panicum miliaceum,	1	–	–	**30.63**	–	–	**5.96**	–	–	**3.84**	–	–	**58.82**	–	–	**26.85**	5.53
Panicum crus-galli,	2	29.28	24.89	**27.08**	11.45	7.98	**9.71**	2.79	2.20	**2.49**	57.88	46.50	**52.20**	29.51	26.31	**27.91**	7.69
White kibi,	2	24.26	22.85	**23.56**	15.14	10.79	**12.97**	1.61	1.50	**1.56**	53.66	52.30	**47.29**	35.29	25.21	**32.10**	6.08
Mochi millet,	3	42.29	30.07	**37.42**	11.90	6.11	**9.94**	1.94	1.74	**1.81**	67.08	49.06	**55.69**	29.80	20.01	**25.56**	7.00
Green oats,	6	55.69	15.51	**25.97**	20.47	7.05	**13.91**	3.95	2.02	**2.89**	50.69	40.42	**44.91**	33.12	25.20	**30.04**	8.25
Green rye,	2	37.89	98.05	**27.97**	9.64	5.38	**7.51**	2.46	1.86	**2.16**	65.37	40.20	**52.79**	42.17	21.52	**31.84**	5.70

Green barley,	1	-	-	20.89	-	-	13.16	-	-	2.91	-	-	37.48	-	-	37.72	8.73
Timothy (*Phleum pratense*),	2	35.00	34.26	34.63	8.83	8.20	8.52	2.07	1.95	2.01	51.33	51.23	51.27	33.23	32.50	32.87	5.33
Hungarian grass (*Setaria Italica* Beauv.),	2	25.93	25.69	25.81	9.39	9.38	9.38	2.43	1.01	1.72	57.80	48.01	52.92	31.23	24.66	27.94	8.04
Vetch and oats (one part vetch and four parts oats),	1	-	-	20.84	-	-	13.27	-	-	3.90	-	-	43.69	-	-	30.34	8.80
Vetch and oats (one part vetch and nine parts oats),	3	24.04	13.89	18.97	10.76	8.83	10.06	2.74	2.29	2.53	49.85	40.10	44.75	35.81	30.77	33.59	9.07
Vetch and oats (equal parts of each),	1	-	-	17.98	-	-	16.77	-	-	2.79	-	-	41.33	-	-	29.80	9.31
Barley and peas,	1	-	-	16.09	-	-	13.40	-	-	3.00	-	-	41.79	-	-	33.49	8.32
Oats and peas,	2	18.41	13.68	16.04	16.01	14.17	15.09	3.40	2.29	2.84	48.14	40.56	44.36	32.20	26.66	29.43	8.28
Horse bean (*Vicia faba*, L.),	1	-	-	15.17	-	-	16.68	-	-	2.31	-	-	47.09	-	-	28.17	5.75
Flat pea (*Lathyrus sylvestris*),	1	-	-	21.38	-	-	30.65	-	-	5.00	-	-	35.06	-	-	20.38	8.91
Soja bean (*Soja hispida*),	14	36.36	18.54	24.48	22.19	13.71	17.26	8.98	2.71	4.57	47.89	34.24	41.73	31.89	21.67	26.47	9.97
Soja bean (early white),	1	-	-	33.44	-	-	17.63	-	-	2.77	-	-	37.23	-	-	27.12	15.25
Soja bean (early green),	1	-	-	30.16	-	-	19.35	-	-	3.87	-	-	40.30	-	-	23.51	12.97
Soja bean (medium black),	1	-	-	23.13	-	-	21.67	-	-	6.76	-	-	37.18	-	-	21.73	12.66
Soja bean (late),	1	-	-	20.22	-	-	18.56	-	-	2.25	-	-	34.24	-	-	23.62	21.33
Kidney vetch (*Anthyllis vulneraria*),	1	-	-	19.15	-	-	18.43	-	-	3.51	-	-	49.84	-	-	14.94	13.28
Cow-pea vines (*Dolichos sinensis*),	3	21.19	18.15	19.63	17.93	11.24	14.59	2.99	1.81	2.48	60.62	46.13	54.42	25.88	21.87	23.59	6.92
Serradella (*Ornithopus sativus* Brot.),	3	19.42	15.40	17.59	17.75	12.17	15.01	2.65	2.09	2.41	46.41	35.45	41.51	38.76	26.21	30.08	10.99
Prickley comfrey (*Symphytum officinale*),	1	-	-	13.21	-	-	17.49	-	-	2.06	-	-	48.30	-	-	11.03	21.12
White lupine (*Lupinus albus*),	1	-	-	14.65	-	-	18.71	-	-	2.41	-	-	42.67	-	-	31.18	5.03
Yellow lupine (*Lupinus lutens*),	1	-	-	13.95	-	-	17.84	-	-	1.87	-	-	42.05	-	-	27.10	11.14
Spanish moss (*Tillandsia usneoides*),	1	-	-	39.20	-	-	4.45	-	-	2.54	-	-	57.73	-	-	32.61	2.67

A. Analyses of Fodder Articles — Continued.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	
II. Hay and Dry Coarse Fodders.																	
English hay (mixed hay),	56	91.94	66.59	**85.53**	14.19	6.19	**9.46**	4.10	1.56	**2.85**	54.72	43.63	**50.29**	35.55	26.41	**31.05**	6.35
Rowen of mixed hays,	14	91.76	75.55	**82.83**	14.70	11.63	**12.60**	5.03	2.60	**3.64**	53.52	41.92	**49.76**	31.50	24.25	**26.82**	7.18
Timothy hay,	6	92.76	81.26	**89.39**	9.37	7.24	**8.66**	2.65	1.95	**2.22**	54.43	50.01	**51.34**	36.59	29.21	**32.90**	4.88
Red-top hay (*Agrostis vulgaris* With.),	4	93.19	91.76	**92.30**	8.40	6.41	**7.88**	1.69	1.50	**1.60**	54.74	50.32	**52.63**	34.11	31.12	**32.92**	4.97
Kentucky blue-grass (*Poa pratensis* L.),	2	96.10	93.22	**94.66**	8.78	8.65	**8.72**	2.08	2.03	**2.06**	49.61	44.11	**46.29**	36.84	32.21	**34.58**	8.35
Orchard grass (*Dactylis glomerata* L.),	4	91.62	90.86	**91.17**	11.29	7.57	**8.99**	3.56	2.40	**2.91**	47.34	43.50	**46.16**	35.79	34.12	**34.89**	7.05
Meadow fescue (*Festuca pratensis* Huds.),	5	94.70	87.84	**91.09**	7.85	5.89	**6.76**	2.17	1.65	**1.87**	49.18	42.03	**46.31**	39.90	34.61	**36.93**	8.13
Perennial rye-grass (*Lolium perenne* L.),	4	93.64	90.50	**92.60**	16.56	6.59	**11.71**	3.15	1.59	**2.37**	55.77	38.82	**48.14**	30.86	26.79	**29.64**	8.14
Italian rye grass (*Lolium Italicum* A. Br.),	4	92.62	90.70	**91.54**	9.75	6.20	**8.15**	2.07	1.39	**1.85**	52.80	43.09	**49.14**	36.90	31.27	**33.34**	7.52
Hungarian grass,	1	-	-	**92.55**	-	-	**9.45**	-	-	**2.22**	-	-	**50.64**	-	-	**31.96**	5.73
Barn-yard grass (*Panicum crus-galli* L.),	1	-	-	**93.35**	-	-	**15.27**	-	-	**1.95**	-	-	**30.24**	-	-	**33.72**	10.02
Hay of black grass,	1	-	-	**91.25**	-	-	**6.72**	-	-	**3.37**	-	-	**49.47**	-	-	**31.41**	9.03
Low meadow hay,	1	-	-	**91.99**	-	-	**9.51**	-	-	**1.88**	-	-	**46.27**	-	-	**35.59**	6.75
Salt hay,	2	91.92	90.34	**91.13**	4.35	3.77	**4.06**	3.24	2.65	**2.95**	60.15	60.14	**60.14**	27.84	27.82	**27.83**	5.02
Millet,	6	93.85	90.25	**92.54**	8.88	7.09	**7.81**	3.63	.89	**2.05**	55.80	49.62	**51.74**	35.91	29.80	**33.32**	5.08
Oats in bloom,	1	-	-	**93.57**	-	-	**6.58**	-	-	**2.82**	-	-	**50.03**	-	-	**34.06**	6.41

Oats in milk,	1	-	-	**90.45**	-	-	**10.89**	-	-	**2.69**	-	-	**46.02**	-	-	**34.32**	6.08
Oats, ripe,	1	-	-	**91.30**	-	-	**6.05**	-	-	**2.61**	-	-	**48.92**	-	-	**36.31**	6.11
Winter rye in bloom,	1	-	-	**91.45**	-	-	**10.66**	-	-	**2.57**	-	-	**47.40**	-	-	**32.97**	6.40
Barley in milk,	1	-	-	**89.75**	-	-	**10.26**	-	-	**2.76**	-	-	**52.91**	-	-	**29.12**	4.95
Common buckwheat,	1	-	-	**91.50**	-	-	**17.90**	-	-	**3.04**	-	-	**45.08**	-	-	**13.35**	14.63
Silver hull buckwheat,	1	-	-	**91.09**	-	-	**12.22**	-	-	**2.55**	-	-	**47.99**	-	-	**27.07**	10.17
Japanese buckwheat,	1	-	-	**94.29**	-	-	**10.80**	-	-	**2.22**	-	-	**38.60**	-	-	**36.02**	12.36
Dry fodder corn,	4	93.35	90.58	**92.11**	9.31	6.17	**7.74**	2.76	1.11	**1.84**	58.89	53.86	**55.97**	33.75	23.03	**29.31**	5.14
Corn stover,	27	94.44	75.00	**88.15**	12.15	5.46	**7.28**	2.63	1.08	**1.38**	63.05	44.65	**50.60**	38.83	20.93	**34.95**	5.79
Teosinte (*Euchlæna luxurians* Dur. and Asch.),	1	-	-	**93.94**	-	-	**9.71**	-	-	**1.28**	-	-	**53.18**	-	-	**28.88**	6.95
Mammoth red clover (*Trifolium medium* L.),	3	92.66	82.47	**88.59**	18.50	14.06	**15.75**	2.25	1.86	**2.13**	48.98	46.51	**44.77**	33.72	20.16	**27.51**	9.84
Alsike clover (*Trifolium hybridum* L.),	6	93.92	86.48	**90.07**	17.55	14.77	**16.63**	3.26	1.88	**2.58**	46.64	38.03	**42.72**	32.34	21.44	**26.17**	11.90
Medium red clover (*Trifolium pratense* L.),	2	94.90	93.98	**94.44**	15.01	14.63	**14.82**	2.62	2.36	**2.49**	43.88	42.81	**43.34**	30.76	29.97	**30.37**	8.98
Lucerne (alfalfa) (*Medicago sativa* Desr.),	5	95.40	84.00	**91.40**	16.34	11.12	**14.22**	2.50	1.04	**1.65**	51.62	40.25	**46.20**	34.39	25.42	**29.72**	8.11
Sand lucerne (*Medicago media* Pers.),	1	-	-	**91.20**	-	-	**16.26**	-	-	**2.59**	-	-	**50.31**	-	-	**21.27**	9.57
Bokhara clover (*Melilotus alba* Desr.)	2	93.64	91.50	**92.57**	14.93	11.81	**13.37**	4.79	1.85	**3.32**	51.36	38.83	**45.08**	33.05	28.08	**30.57**	7.66
Blue melilot (*Melilotus cœrulea* Desr.),	1	-	-	**91.78**	-	-	**13.81**	-	-	**1.67**	-	-	**42.48**	-	-	**27.17**	14.87
Sanfoin (*Onobrychis sativa*),	1	-	-	**87.83**	-	-	**17.70**	-	-	**4.49**	-	-	**42.32**	-	-	**26.95**	8.54
Sulla (*Hedysarum coronarium*),	2	91.68	89.59	**90.61**	17.03	16.90	**16.97**	3.16	2.39	**2.78**	58.66	41.80	**50.26**	28.95	12.38	**20.67**	9.32
Hairy lotus (*Lotus villosus* Thuill.),	2	89.32	87.64	**88.48**	16.12	13.49	**14.81**	3.00	2.69	**2.85**	57.82	50.80	**54.29**	24.48	15.07	**19.78**	8.27
Summer rape (*Brassica napus*),	1	-	-	**88.87**	-	-	**14.43**	-	-	**3.79**	-	-	**45.38**	-	-	**18.15**	18.25
Soja bean,	4	93.88	79.91	**87.78**	19.06	14.89	**16.23**	8.33	2.55	**4.72**	51.28	41.09	**46.70**	27.73	20.76	**24.02**	8.33

A. Analyses of Fodder Articles — Continued.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	
II. Hay and Dry Coarse Fodders — Concluded.																	
Cow-pea,	3	90.70	90.25	**90.43**	17.17	16.95	**17.05**	4.49	3.81	**4.06**	51.41	46.06	**47.93**	23.58	19.06	**21.67**	9.29
Small pea (*Lathyrus sativus*),	1	–	–	**94.20**	–	–	**16.57**	–	–	**1.49**	–	–	**42.76**	–	–	**32.88**	6.30
Flat pea (*Lathyrus sylvestris*),	1	–	–	**91.10**	–	–	**24.04**	–	–	**1.78**	–	–	**33.03**	–	–	**31.76**	9.39
Serradella,	3	92.80	87.23	**90.44**	17.97	15.26	**17.03**	2.91	2.37	**2.55**	50.22	44.49	**48.18**	25.92	24.37	**25.15**	7.09
Hairy vetch (*Vicia villosa* Roth.),	1	–	–	**92.56**	–	–	**19.58**	–	–	**1.22**	–	–	**38.95**	–	–	**31.88**	8.37
Common vetch (*Vicia sativa* L.),	2	91.65	90.55	**91.10**	15.76	14.42	**15.09**	2.69	2.30	**2.50**	44.34	43.29	**43.80**	30.68	30.05	**30.37**	8.24
Scotch tares,	1	–	–	**84.20**	–	–	**22.00**	–	–	**1.89**	–	–	**31.46**	–	–	**30.89**	13.76
Vetch and oats,	3	94.22	83.33	**88.35**	13.51	7.70	**9.64**	3.45	2.53	**3.11**	49.95	41.51	**46.83**	36.22	30.15	**32.70**	7.72
Horse-bean straw,	1	–	–	**90.85**	–	–	**9.69**	–	–	**1.51**	–	–	**37.77**	–	–	**41.44**	9.59
Soja-bean straw,	3	92.37	86.03	**88.57**	5.73	5.34	**5.48**	3.49	1.17	**2.15**	43.72	41.02	**42.81**	46.51	36.80	**42.38**	7.18
White daisy (*Chrysanthemum leucanthemum* L.),	1	–	–	**90.35**	–	–	**7.68**	–	–	**2.32**	–	–	**46.86**	–	–	**36.09**	7.05
Dry carrot tops,	1	–	–	**90.24**	–	–	**20.12**	–	–	**2.01**	–	–	**50.39**	–	–	**13.61**	13.87
Wheat straw,	1	–	–	**93.80**	–	–	**7.20**	–	–	**1.63**	–	–	**50.46**	–	–	**35.91**	4.80
Barley straw,	1	–	–	**88.56**	–	–	**9.24**	–	–	**3.38**	–	–	**48.23**	–	–	**33.85**	5.30
Japanese millet (white head),	1	–	–	**91.48**	–	–	**7.67**	–	–	**2.41**	–	–	**49.87**	–	–	**34.99**	5.06
Japanese millet (red head),	1	–	–	**91.13**	–		**5.76**	–	–	**1.70**	–	–	**49.66**	–	–	**39.52**	3.36

Millet straw,	1	-	-	86.55	-	-	4.95	-	-	1.43	-	-	44.96	-	-	41.82	6.84
Straw (*Panicum crus-galli*),	1	-	-	87.35	-	-	6.10	-	-	2.44	-	-	50.20	-	-	35.90	5.36
Straw (*P. miliaceum*),	1	-	-	87.83	-	-	3.94	-	-	3.01	-	-	44.72	-	-	42.16	6.17
Straw (*P. Italicum*),	1	-	-	80.28	-	-	4.17	-	-	1.59	-	-	46.39	-	-	41.54	6.31
III. Roots, Bulbs, Tubers, etc.																	
Beets, red,	7	14.51	9.75	12.17	15.40	7.82	12.29	1.76	.59	.94	79.33	66.87	72.19	7.56	4.29	6.00	8.58
Beets, sugar,	12	19.53	9.87	14.60	17.44	7.32	11.18	.83	.58	.67	81.50	61.93	75.62	9.69	4.82	6.55	5.98
Beets, yellow fodder,	4	15.01	9.40	11.46	13.96	9.29	11.69	2.02	.84	1.39	75.22	61.90	69.33	9.66	7.26	8.14	9.45
Mangolds,	4	13.08	11.49	12.06	12.84	7.04	9.54	1.14	.73	.97	73.38	70.32	71.03	9.98	7.08	8.45	10.01
Ruta-bagas,	3	12.77	8.25	10.88	11.46	10.34	11.01	2.32	1.23	1.53	68.58	62.27	65.88	13.12	11.03	11.83	9.75
Turnips,	4	12.80	8.22	10.11	11.12	9.67	10.37	2.05	1.42	1.68	70.62	65.91	57.37	13.34	10.12	11.75	8.83
Carrots,	4	12.52	9.95	11.15	9.75	7.98	9.13	3.94	1.41	2.11	73.96	67.24	70.12	10.76	7.55	9.09	8.55
Parsnips,	1	-	-	19.66	-	-	6.88	-	-	3.37	-	-	74.65	-	-	7.67	7.43
Potatoes,	10	21.95	13.91	18.78	13.56	6.24	10.01	.83	.17	.48	87.56	78.80	81.50	3.55	1.91	2.75	5.26
Artichokes,	1	-	-	22.51	-	-	12.82	-	-	.95	-	-	77.26	-	-	4.18	4.79
Japanese radish (*merinia*),	1	-	-	6.74	-	-	7.47	-	-	1.05	-	-	70.89	-	-	10.27	10.32
Japanese radish (*niyas hige*),	1	-	-	7.42	-	-	6.51	-	-	.96	-	-	72.87	-	-	9.79	9.87
IV. Grains, Seeds, Fruits, etc.																	
Corn kernels,	29	91.98	65.50	89.43	15.02	8.49	12.18	9.43	4.25	5.42	83.98	71.06	78.49	3.38	1.03	2.12	1.69
Sweet corn kernels,	1	-	-	88.02	-	-	12.57	-	-	9.56	-	-	73.83	-	-	2.41	1.63
Wheat kernels,	1	-	-	89.42	-	-	13.35	-	-	1.79	-	-	80.26	-	-	2.42	2.18

A. Analyses of Fodder Articles — Continued.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	
IV. Grains, Seeds, Fruits, etc. — Concluded.																	
Oat kernels,	1	–	–	86.84	–	–	14.44	–	–	6.83	–	–	66.21	–	–	9.03	3.49
Broom-corn seed,	1	–	–	85.90	–	–	11.21	–	–	4.05	–	–	74.05	–	–	8.34	2.35
Soja beans,	3	94.15	80.73	85.83	35.98	32.58	33.97	21.89	18.42	20.19	34.88	32.87	33.98	7.57	5.15	6.02	5.84
Horse beans,	1	–	–	89.72	–	–	30.03	–	–	1.11	–	–	56.48	–	–	8.11	4.27
Red adzinki beans,	2	85.18	83.10	84.14	25.14	23.75	24.45	.88	.76	.82	66.48	65.41	65.95	4.68	4.50	4.59	4.19
Saddle beans,	1	–	–	87.62	–	–	15.12	–	–	16.58	–	–	57.34	–	–	4.75	6.21
Daidzu beans,	1	–	–	88.47	–	–	38.99	–	–	18.59	–	–	30.41	–	–	4.97	7.04
Millet seed,	3	87.32	86.11	86.65	14.60	11.76	13.24	4.94	3.53	4.32	73.19	66.94	70.56	10.23	6.48	8.88	3.00
Chestnuts,	1	–	–	55.14	–	–	13.32	–	–	14.46	–	–	67.05	–	–	2.45	2.72
Cranberries,	1	–	–	10.59	–	–	4.40	–	–	5.61	–	–	76.37	–	–	11.63	1.99
Apples,	2	24.83	19.68	22.26	4.57	3.92	4.25	2.81	1.71	2.26	86.21	83.44	84.81	7.05	6.14	6.60	2.08
V. Flour and Meal.																	
Corn meal,	34	89.95	79.81	86.24	16.08	9.73	11.04	5.08	3.10	3.83	83.61	73.20	81.41	3.60	1.20	2.15	1.57
Corn and cob meal,	37	94.00	80.89	89.47	15.06	7.82	10.01	5.27	3.36	4.19	81.41	70.13	76.62	10.41	5.63	7.54	1.64
Cooked feed (oats and corn),	1	–	–	94.45	–	–	14.75	–	–	5.34	–	–	67.14	–	–	8.73	4.04

Hominy meal,	4	–	–	90.00	4.15	3.00	3.57	.67	.38	.57	63.62	60.58	61.72	33.77	31.36	32.93	1.21
Ground oats,	1	–	–	90.29	–	–	13.20	–	–	3.51	–	–	70.07	–	–	9.29	3.93
Ground barley,	4	89.09	82.59	86.44	14.93	10.42	12.46	2.38	1.69	2.10	78.25	74.47	76.83	7.37	4.10	5.84	2.77
Broom-corn meal,	1	–	–	86.46	–	–	11.14	–	–	4.13	–	–	74.30	–	–	8.00	2.43
Pea meal,	1	–	–	91.15	–	–	20.95	–	–	1.67	–	–	55.02	–	–	19.42	2.94
Bean meal,	1	–	–	88.02	–	–	12.57	–	–	9.56	–	–	73.83	–	–	2.41	1.63
Soja-bean meal,	1	–	–	89.20	–	–	41.18	–	–	18.17	–	–	30.60	–	–	5.01	5.04
Millet meal (*Panicum Italicum*),	1	–	–	89.38	–	–	35.12	–	–	17.35	–	–	38.95	–	–	3.86	4.72
VI. By-products and Refuse.																	
Linseed cake, old process,	8	92.52	88.50	90.32	39.97	83.98	36.65	9.87	6.24	7.30	44.72	37.76	40.51	9.69	8.04	8.62	6.92
Linseed cake, new process,	7	94.94	88.17	91.65	41.02	35.03	39.38	4.08	2.17	3.24	46.49	40.54	41.74	10.31	8.59	9.28	6.36
Cotton-seed meal,	24	94.42	88.81	91.94	51.79	36.54	44.22	14.72	9.47	12.15	35.84	20.22	29.30	10.83	5.08	7.70	7.53
Wheat bran,	40	92.58	86.30	89.34	20.54	15.67	17.86	6.08	2.80	4.98	62.83	51.77	58.36	14.26	7.49	10.98	7.82
Spring-wheat bran,	3	91.03	87.26	88.67	19.54	16.19	17.78	5.46	5.37	5.41	59.39	56.54	57.50	13.75	10.84	12.02	7.29
Winter-wheat bran,	2	87.76	86.94	87.35	17.04	16.24	16.64	4.57	3.43	4.00	62.83	59.83	61.33	12.74	9.32	11.03	7.00
Wheat middlings,	7	90.75	87.57	89.76	20.07	15.13	17.19	6.46	3.19	5.40	74.30	58.03	62.46	11.21	1.40	8.46	6.49
Rye bran,	2	91.82	86.30	89.06	18.98	16.52	17.75	3.03	2.07	2.55	73.56	69.24	71.70	4.54	3.46	4.00	4.30
Rye middlings,	1	–	–	87.46	–	–	13.15	–	–	5.61	–	–	73.52	–	–	3.70	4.02
Pea bran,	1	–	–	92.86	–	–	10.31	–	–	1.16	–	–	39.04	–	–	46.16	3.33
Buckwheat middlings,	1	–	–	88.49	–	–	25.49	–	–	7.53	–	–	66.36	–	–	5.18	5.44
Gluten meal,	38	93.67	68.32	90.98	39.28	25.75	29.99	14.47	3.92	9.13	66.26	48.26	56.34	10.06	.41	3.59	.95
Gluten meal (Chicago),	2	92.71	88.89	90.80	33.34	30.19	31.76	9.22	6.56	7.89	–	–	57.97	–	–	.73	1.65

A. *Analyses of Fodder Articles* — Concluded.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	
VI. By-products and Refuse — Concluded.																	
Gluten feed (Buffalo),	10	93.67	90.61	91.90	31.05	21.11	25.69	14.47	9.18	12.08	62.79	48.80	53.12	10.06	5.43	7.00	1.11
Gluten feed (Pope),	1	–	–	86.02	–	–	38.68	–	–	16.34	–	–	42.43	–	–	1.80	.75
Maize feed (Chicago),	3	91.40	90.25	90.95	29.40	21.33	25.47	7.90	6.15	6.96	62.12	53.85	58.27	9.65	7.93	8.53	.77
Starch feed (Pope),	1	–	–	94.52	–	–	11.28	–	–	11.30	–	–	61.31	–	–	15.21	.90
Glucose feed (Richardson),	1	–	–	93.68	–	–	23.12	–	–	11.67	–	–	52.41	–	–	11.67	1.13
Corn-germ meal,	1	–	–	90.65	–	–	28.26	–	–	11.82	–	–	42.49	–	–	9.18	8.25
Corn-germ feed,	1	–	–	92.45	–	–	10.81	–	–	12.17	–	–	62.10	–	–	14.05	.87
Corn screenings,	1	–	–	88.98	–	–	8.29	–	–	4.48	–	–	81.57	–	–	3.27	2.39
Proteina (mixed feed),	4	93.20	89.94	91.61	27.23	20.53	23.67	8.24	5.01	7.20	61.53	51.11	55.55	12.33	10.18	10.92	2.66
Excelsior feed,	1	–	–	92.92	–	–	6.75	–	–	5.42	–	–	65.75	–	–	14.65	4.43
Corn screenings,	1	–	–	88.98	–	–	8.29	–	–	4.48	–	–	81.57	–	–	3.27	2.39
Oat feed,	2	90.66	90.53	90.59	15.60	14.06	14.83	8.23	4.28	6.25	68.08	64.52	66.31	8.79	8.06	8.42	4.19
Rye feed,	1	–	–	90.37	–	–	13.56	–	–	2.79	–	–	77.51	–	–	3.52	2.62
Starch feed (Pope),	1	–	–	94.52	–	–	11.28	–	–	11.30	–	–	61.31	–	–	15.21	.90
Cocoanut meal,	1	–	–	90.67	–	–	22.61	–	–	12.88	–	–	40.03	–	–	18.80	5.68
Louisiana rice bran,	1	–	–	89.75	–	–	9.82	–	–	9.66	–	–	55.07	–	–	14.86	10.59

Bakery refuse,	1	-	-	86.66	-	-	9.23	-	-	6.36	-	-	72.34	-	-	.43	11.64
Vinegar mash,	1	-	-	5.51	-	-	16.50	-	-	8.45	-	-	63.47	-	-	8.55	3.03
Refuse from starch works,	1	-	-	42.96	-	-	22.41	-	-	10.17	-	-	58.98	-	-	7.54	.90
Oat meal and barley refuse,	1	-	-	92.24	-	-	7.45	-	-	3.80	-	-	62.61	-	-	22.30	3.84
Glucose refuse,	1	-	-	93.29	-	-	21.06	-	-	10.55	-	-	62.42	-	-	4.77	1.20
Spent brewers' grain,	4	93.02	88.00	90.13	33.16	16.08	23.29	6.29	1.95	4.89	67.62	42.32	54.04	15.90	8.07	11.25	4.53
Malt sprouts,	1	-	-	84.63	-	-	27.17	-	-	3.85	-	-	47.92	-	-	14.75	6.31
Damaged wheat,	1	-	-	86.90	-	-	16.26	-	-	2.51	-	-	75.85	-	-	3.11	2.31
Cocoa dust from cocoa manufactory,	1	-	-	92.90	-	-	15.47	-	-	25.85	-	-	45.99	-	-	5.86	6.83
Broom-corn waste,	1	-	-	91.30	-	-	6.78	-	-	1.00	-	-	48.09	-	-	39.25	4.88
Refuse from cows' manger,	4	85.73	64.81	77.44	6.63	4.34	5.01	1.09	.74	.98	45.46	42.12	43.74	46.91	38.72	43.94	6.33
Refuse from cows' manger (ensilage),	6	39.89	21.73	27.07	11.56	8.64	8.38	2.04	1.30	1.48	44.96	41.67	45.97	40.37	33.98	34.57	9.60
Cotton hulls,	3	91.85	88.55	89.98	5.36	4.10	4.79	4.27	1.79	2.81	46.75	38.59	43.34	51.40	40.24	46.08	2.98
Apple pomace,	2	21.78	17.22	19.50	7.73	6.94	7.34	4.37	3.17	3.78	72.93	70.20	72.56	16.58	13.15	14.86	1.46
Apple pomace ensilage,	1	-	-	14.67	-	-	8.22	-	-	7.36	-	-	58.03	-	-	22.18	4.21
Sugar beet pulp, from diffusion battery,	1	-	-	10.32	-	-	12.41	-	-	.95	-	-	61.86	-	-	23.74	1.04
Corn cobs,	6	94.05	90.00	92.35	4.15	1.46	2.91	.77	.38	.56	63.62	58.78	61.21	37.84	31.36	33.96	1.36
Palmetto root,	1	-	-	88.49	-	-	3.82	-	-	.53	-	-	69.95	-	-	21.26	4.44

B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients.*

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	*Valuation per 2,000 Pounds.
I. Green Fodders.												
Fodder corn,	14	78.61	.407	4.84	.327	.048	.153	.091	.018	.148	.380	$1 93
Fodder corn ensilage,	6	78.46	.341	–	.385	.050	.100	.090	.020	.129	.255	1 74
Corn and soja-bean ensilage,	1	71.03	.790	–	.444	–	–	–	–	.420	–	3 67
Ensilage of *Panicum miliaceum*,	1	78.01	.260	–	.430	–	–	–	–	.110	.500	1 49
Ensilage of *Panicum crus-galli*,	1	76.75	.294	–	.621	–	–	–	–	.133	–	1 84
Sorghum,	7	82.19	.233	–	.229	.025	.076	.075	.012	.088	.136	1 16
White kibi,	2	76.45	.489	1.22	.200	.045	.232	.148	.019	.136	.652	2 07
Mochi millet,	3	62.58	.609	2.62	.407	.120	.201	.217	.021	.188	.708	2 76
Millet (*Panicum crus-galli*),	1	75.11	.455	–	.494	–	–	–	–	.109	–	2 24
Green oats,	3	83.36	.489	1.31	.381	.217	.154	.134	.018	.130	.496	2 26
Green rye,	2	72.03	.302	–	.636	–	–	–	–	.117	–	1 87
Vetch and oats,	1	86.11	.236	1.72	.789	.031	.087	.030	.012	.094	.331	1 78
Horse bean,	1	74.71	.675	–	.346	.028	.346	.157	.050	.083	.514	2 85
Soja bean,	1	73.20	.292	–	.531	–	–	–	–	.151	–	1 76
Soja bean (early white),	1	66.56	.943	–	.905	–	–	–	–	.214	–	4 51

Soja bean (early green),	1	69.84	.835	-	.707	-	-	-	-	.201	-	3 90
Soja bean (medium black),	1	76.87	.803	-	.566	-	-	-	-	.175	-	3 61
Soja bean (late),	1	79.78	.600	-	.677	-	-	-	-	.138	-	2 98
Kidney vetch,	1	80.85	.563	-	.346	.218	.907	.055	.027	.085	.155	2 46
Cow-pea vines,	1	78.81	.274	1.47	.306	.063	.300	.099	.016	.098	.077	1 39
Prickley comfrey,	1	86.79	.370	-	.759	.122	.309	.041	.058	.115	-	2 24
Serradella,	2	82.59	.411	1.82	.420	.097	.460	.067	.021	.140	.097	2 04
Common buckwheat,	1	84.65	.440	-	.538	-	-	-	-	.089	.577	2 22
Flat pea (*Lathyrus sylvestris*),	1	78.62	1.049	-	.449	-	.302	.088	.056	.140	.247	4.30
Hungarian grass,	1	74.31	.386	-	.549	-	-	-	-	.159	-	2 11
White lupine,	1	85.35	.440	-	.253	.100	.450	.107	.025	.051	.131	1 87
Yellow lupine,	1	85.05	.398	-	.441	.086	.288	.049	.008	.092	.161	1 49
Spanish moss,	1	60.80	.279	1.04	.255	.263	.089	.122	.029	.030	.191	1 30
II. Hay and Dry Coarse Fodders.												
English hay,	10	11.94	1.294	6.34	1.528	.110	.344	.240	.021	.286	.911	6 49
Rowen,	12	18.52	1.609	9.57	1.486	.140	.640	.280	.034	.432	1.840	7 70
Timothy hay,	3	11.26	1.240	4.93	1.460	.180	.620	.120	.006	.342	1.000	6 28
Red-top,	4	7.71	1.150	4.59	1.020	.438	.571	.134	.036	.360	1.736	5 51
Kentucky blue grass,	2	5.34	1.320	-	1.694	.129	.398	-	.044	.431	2.863	6 91

* The valuation is based on the following prices per pound of the essential fertilizing ingredients: nitrogen, 17½ cents; potassium oxide, 5½ cents; phosphoric acid, 5 cents.

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients — Continued.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	*Valuation per 2,000 Pounds.
II. Hay and Dry Coarse Fodders — Concluded.												
Orchard grass,	4	8.84	1.310	6.42	1.879	.225	.456	.297	.033	.414	2.060	$7 07
Meadow fescue,	6	8.89	.992	8.08	2.096	.301	.576	.187	.028	.399	1.537	6 18
Perennial rye-grass,	2	9.13	1.227	6.79	1.553	.307	.642	.337	.044	.559	2.262	6 56
Italian rye-grass,	4	8.71	1.189	-	1.273	.451	.857	.321	.071	.556	2.598	6 13
Salt hay,	1	5.36	1.180	-	.718	.017	.371	.335	.028	.248	-	4 46
Japanese millet (white head),	3	10.45	1.105	5.80	1.223	.012	.465	.377	.028	.403	1.033	5 62
Common buckwheat,	1	8.50	2.620	-	3.208	-	-	-	-	.532	3.436	13 04
Silver-hull buckwheat,	1	8.91	1.780	-	2.380	-	2.290	.526	.059	.860	.462	9 71
Japanese buckwheat,	1	5.72	1.629	-	3.320	.349	3.418	.421	.148	.852	.378	10 21
Fodder corn,	7	7.85	1.763	4.91	.889	.175	.605	.500	.075	.542	1.270	7 69
Corn stover,	17	9.33	1.038	3.74	1.375	.112	.622	.384	.068	.288	1.782	5 43
Teosinte,	1	6.06	1.460	6.53	3.696	.109	1.597	.458	.021	.546	.315	9 72
Summer rape,	1	11.13	2.053	-	4.670	.994	3.691	.522	.031	.572	.709	12 89
Millet hay,	1	9.75	1.280	-	1.690	.020	.500	.460	.030	.490	1.360	6 83
Mammoth red clover,	3	11.41	2.231	8.72	1.223	.389	3.141	.613	.111	.546	.779	9 98

Medium red clover,	2	7.91	2.184	8.36	2.286	.210	1.689	.402	.099	.447	.919	10 61
Alsike clover,	6	9.94	2.342	11.11	2.227	.309	2.153	.537	.197	.668	1.776	11 31
Lucerne (alfalfa),	4	6.26	2.075	6.82	1.461	.814	2.211	.406	.078	.526	.513	9 40
Bokhara clover,	2	7.43	1.975	7.70	1.832	.114	1.784	.347	.023	.558	.057	9 49
Blue melilot,	1	8.22	1.919	13.65	2.796	.270	1.449	.260	.349	.544	4.008	10 34
Sainfoin,	1	12.17	2.630	7.55	2.020	.540	1.160	.430	.040	.760	.470	12 19
Sulla,	2	9.39	2.460	-	2.093	.223	2.497	.350	.114	.453	.614	11 37
Lotus villosus,	2	11.52	2.095	8.23	1.807	.499	2.220	.476	.112	.594	.976	9 91
Soja bean,	2	6.30	2.320	6.47	1.079	.148	2.760	1.178	.115	.667	.977	9 97
Cow pea,	1	9.00	1.635	8.40	.913	.122	2.696	.688	.046	.527	.832	7 25
Small pea,	1	5.80	2.497	-	1.990	.469	1.373	.276	.138	.592	1.081	11 52
Flat pea (*Lathyrus sylvestris*),	1	8.90	3.514	-	2.340	-	1.631	.454	.179	.820	1.830	15 69
Serradella,	2	7.39	2.697	10.60	.652	.656	2.545	.461	.066	.777	.590	11 97
Scotch tares,	1	15.80	2.964	-	3.004	.238	1.698	.354	.460	.815	4.062	14 49
Spring vetch,	1	8.21	2.204	-	2.760	-	1.710	-	-	.740	.510	11 48
Vetch and oats,	3	9.91	1.299	9.58	1.349	.420	.663	.265	.098	.560	.521	6 59
Soja-bean straw,	1	13.00	.714	-	1.060	-	.436	.469	.035	.259	.218	3 92
Millet straw,	1	13.45	.690	-	1.760	-	-	-	-	.180	.580	4 63
White daisy,	1	9.65	.279	6.37	1.253	.164	1.302	.191	.032	.435	1.110	2 78
Dry carrot tops,	1	9.76	3.130	12.52	4.883	4.028	2.089	.667	.118	.612	.098	16 94
Barley straw,	1	11.44	1.310	5.30	2.086	.183	.572	.180	-	.303	2.380	7 18

* See note on page 359.

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients — Continued.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per 2,000 Pounds.
III. Roots, Bulbs, Tubers, etc.												
Beets, red,	8	87.82	.229	1.13	.440	.091	.049	.033	.004	.092	.020	$1 37
Beets, sugar,	4	86.95	.223	1.04	.477	.081	.057	.040	.013	.101	.048	1 40
Beets, yellow fodder,	1	90.60	.192	.95	.462	.104	.045	.030	.005	.086	.015	1 26
Mangolds,	2	87.29	.188	1.22	.383	.125	.061	.039	.005	.093	.023	1 17
Ruta-bagas,	3	89.13	.190	1.06	.489	.070	.088	.030	.004	.123	.012	1 33
Turnips,	3	89.29	.163	1.01	.381	.078	.089	.027	.009	.115	.112	1 10
Carrots,	2	89.03	.162	9.22	.471	.062	.067	.023	.009	.090	.040	1 23
Parsnips,	1	80.34	.217	-	.617	.006	.088	.045	.005	.187	.019	1 63
Potatoes,	1	79.75	.207	.99	.294	.013	.007	.020	.002	.066	.006	1 11
Artichokes,	1	77.49	.460	-	.484	-	-	-	-	.168	.069	2 31
Japanese radish (*merinia*),	1	93.26	.081	-	.281	-	-	-	-	.047	-	0 64
Japanese radish (*niyas hige*),	1	92.58	.077	-	.338	-	-	-	-	.050	-	0 79
IV. Grains.												
Corn kernels,	13	10.88	1.822	1.53	.404	.034	.032	.206	.019	.699	.020	7 52
Corn and cob meal,	29	8.96	1.409	-	.472	.059	.018	.176	.011	.571	.430	6 02

Oat kernels,	1	9.04	2.100	-	-	-	-	-	-	-	-	-
Soja beans,	2	18.33	5.303	4.99	1.991	.275	.419	.909	.216	1.869	.093	22 63
Red adzinki beans,	1	14.82	3.240	-	1.540	.035	.090	.210	.180	.940	.050	14 07
White adzinki beans,	1	16.99	3.330	-	1.480	.190	.130	.220	.021	.970	.130	14 14
Saddle beans,	1	12.38	2.120	-	2.130	.020	.250	.430	.032	1.520	.250	11 28
Daidzu beans,	1	11.53	5.520	-	1.960	.210	.220	.400	.050	1.480	.280	22 96
Japanese millet,	2	13.68	1.730	-	.380	.030	.045	.225	.015	.685	-	7 16
Common millet,	1	12.68	2.040	-	.360	.060	.040	.260	.030	.850	.143	8 38
Chestnuts,	1	44.86	1.175	2.72	.632	-	.060	.135	.010	.392	.069	5 51
Cranberries,	1	89.41	.075	-	.097	-	.018	.013	.005	.028	-	0 40
Apples,	2	79.91	.130	.41	.190	.030	.030	.030	.003	.010	.003	0 57
V. Flour and Meal.												
Corn meal,	3	14.13	1.920	1.42	.337	.064	.034	.187	.015	.714	.060	7 80
Hominy feed,	1	8.93	1.630	2.21	.490	-	.180	.280	-	.980	-	7 22
Ground barley,	1	13.43	1.550	2.06	.341	.169	.091	.173	.013	.660	.669	6 46
Wheat flour,	2	12.14	2.020	1.22	.359	-	.170	.050	-	.352	-	8 89
Pea meal,	1	8.85	3.080	2.68	.993	.618	.302	.302	.027	.820	.122	12 69
Soja-bean meal,	1	10.80	5.89	-	2.230	-	-	-	-	1.570	.280	24 64
VI. By-products and Refuse.												
Linseed meal, old process,	4	8.02	5.390	6.57	1.214	.860	.664	.763	.060	1.780	.340	21 98
Linseed meal, new process,	5	7.96	5.828	5.04	1.246	.823	.663	.655	.062	1.692	.345	24 26

* See note on page 359.

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients — Concluded.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per 2,000 Pounds.
VI. By-products and Refuse. — Concluded.												
Cotton-seed meal,	15	8.83	6.494	6.49	1.686	.291	.587	.589	.020	2.366	.322	$26 84
Wheat bran,	8	11.07	2.620	6.44	1.579	.159	.168	.899	.019	2.461	.182	13 37
Wheat middlings,	2	10.15	2.745	2.30	.750	.110	.200	.210	-	1.245	-	11 67
Rye middlings,	1	12.54	1.840	3.52	.810	.030	.090	.320	.020	1.260	.170	8 59
Rye feed,	1	9.63	1.950	-	.980	-	-	-	-	1.561	-	9 43
Gluten meal,	5	8.53	5.090	.65	.047	.018	.050	.035	.009	.420	-	18 28
Gluten feed (Buffalo),	4	8.11	3.724	-	.060	-	-	-	-	.348	.160	13 45
Spent brewers' grain,	2	8.58	2.680	6.15	.853	.347	.296	.286	.159	1.045	1.770	11 36
Proteina,	1	10.06	2.970	-	.570	-	-	-	-	1.00	-	12 02
Damaged wheat,	1	13.10	2.260	-	.505	-	-	-	-	.831	-	9 30
Louisiana rice bran,	1	10.25	1.430	-	.840	-	-	-	-	1.710	-	7 64
Glucose refuse,	1	6.71	3.370	-	.090	-	-	-	-	.610	-	12 50
Cocoa dust,	1	7.10	2.299	6.35	.630	-	.630	-	-	1.340	-	10 08
Broom-corn waste (stalks),	1	10.37	.870	4.70	1.858	-	.242	.170	-	.460	1.000	5 55
Cotton hulls,	3	10.63	.750	2.61	1.080	-	.200	.260	-	.180	.060	3 99

Apple pomace,	2	80.50	.227	.271	.134	.026	.037	.028	.008	.018	.009	0 96
Corn cobs,	8	12.09	.504	.815	.598	.071	.025	.045	.009	.063	.190	2 48
Palmetto roots,	1	11.51	.540	3.93	1.380	.345	.045	.004	.017	.157	.410	3 57
Buckwheat hulls,	1	11.90	.490	–	.521	–	.247	.236	.020	.073	.066	2 36
VII. Dairy Products.												
Buttermilk,	1	91.13	.510	.810	.046	–	.045	–	–	.041	–	1 88
Skim-milk,	19	90.29	.586	.788	–	–	–	–	–	–	–	–
Whey,	1	93.68	.102	–	.0723	–	–	–	–	.173	–	0 62

* See note on page 359.

C. Analyses of Fruits.

NAME.	Date.	Dry Matter.	Specific Gravity of Juice.	Temperature C. of Juice (Degrees).	Total Sugar in Juice.	Glucose in Juice.	Cane Sugar in Juice.	*Soda Sol. required to neutralize 100 parts Juice.
	1877.	Per ct.			Per ct.	Per ct.	Per ct.	C. C.
Apple (Baldwin), . . .	Sept. 1,	20.14	1.055	12—15	3.09	–	–	–
Apple (Baldwin), . . .	Oct. 9,	19.66	1.065	12—15	6.25	–	–	–
Apple (Baldwin), . . .	Nov. 27,	–	1.075	12—15	10.42	–	–	–
Rhode Island Greening, . .	Sept. 1,	20.27	1.055	12—15	3.16	–	–	–
Rhode Island Greening, . .	Oct. 9,	19.68	1.066	12—15	7.14	–	–	–
Rhode Island Greening,† . .	Nov. 27,	20.25	1.080	12—15	11.36	–	–	–
Pear (Bartlett), . . .	Aug. 31,	15.00	1.060	12—15	4.77	–	–	–
Pear (Bartlett), . . .	Sept. 7,	16.55	1.060	12—15	5.68	–	–	–
Pear (Bartlett), . . .	Sept. 20,	–	1.065	12—15	8.62	–	–	–
Pear (Bartlett),‡ . . .	Sept. 22,	–	1.060	12—15	8.93	–	–	–
Cranberries, ...	–	10.71	1.025	15	1.35	–	–	–§
Cranberries, ...	1878.	10.11	1.025	15	1.70	–	–	–‖
Early York Peach (ripe), .	–	–	1.045	25	–	1.92	6.09	45
Early York Peach (nearly ripe),	–	10.96¶	1.039	25	–	1.36	4.12	42.3
Crawford Peach (nearly ripe),	–	–	1.050	18	–	2.19	7.02	85.6
Crawford Peach (mellow), .	–	11.36¶	1.055	18	–	1.70	8.94	76
Crawford Peach (not mellow),	–	11.88¶	1.045	22	–	1.67	5.92	64

* One part Na_2CO_3 in 100 parts of water.
† Picked October 9.
‡ Picked September 7.
§ Free acid, 2.25 per cent.
‖ Free acid, 2.43 per cent.
¶ In pulp, kept ten days before testing.

C. Analyses of Fruits — Continued.

[Wild and cultivated grapes.]

NAME.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter.	Glucose in Juice.	Sugar in Dry Matter.	*Soda Sol. required to neutralize 100 parts Juice.
	1876.			Per ct.	Per ct.	Per ct.	C.C.
Concord, ...	July 17,	1.0175	31	8.30	.645	7.77	–
Concord, ...	July 20,	1.0150	31	8.10	.625	7.72	216
Concord, ...	Aug. 2,	1.0200	25	9.94	.938	9.44	249
Concord, ...	Aug. 16,	1.0250	28	10.88	2.000	18.38	229
Concord, ...	Aug. 30,	1.0500	25	15.58	8.620	55.33	120
Concord, ...	Sept. 13,	1.0670	23	17.48	13.890	79.46	55
Concord, ...	Sept. 4,	1.0700	18	19.82	16.130	81.38	49.2
Wild Purple Grape, . . .	July 19,	1.020	31	9.00	.714	7.93	204
Wild Purple Grape, . . .	Aug. 4,	1.020	28	12.25	1.100	8.98	246
Wild Purple Grape, . . .	Aug. 16,	1.025	28	12.48	2.000	16.03	233
Wild Purple Grape, . . .	Aug. 30,	1.050	26	16.58	6.500	39.81	147.6
White Wild Grape, . . .	Aug. 31,	1.050	26	16.48	9.260	56.18	98
Hartford Prolific, ...	Sept. 5,	1.060	22	17.39	13.89	79.87	88.8
Ives' seedling, ...	Sept. 6,	1.070	26	20.15	15.15	75.14	88.6
Iona, ...	Sept. 7,	1.080	21	24.56	15.15	61.68	144
Iona (mildewed), ...	Sept. 7,	1.045	26	15.41	6.25	40.56	204.4
Agawam, ...	Sept. 11,	1.075	20	20.79	17.24	82.92	94.8
Wilder, ...	Sept. 11,	1.064	20	16.53	13.67	82.69	56
Delaware, ...	Sept. 12,	1.080	24	23.47	17.86	76.09	74
Charter Oak, ...	Sept. 12,	1.080	24	15.98	8.77	54.94	168.3
Israella, ...	Sept. 16,	1.075	23	19.67	9.20	46.77	89.8
Bent's Seedling, ...	Sept. 20,	1.080	21	20.65	16.13	78.11	181.8
Adirondack, ...	Sept. 20,	1.065	21	15.11	13.17	87.16	68
Catawba, ...	Oct. 16,	1.080	13	23.45	17.39	74.16	82
	1877.						
Wilder, ...	Sept. 11,	1.065	23	16.41	15.15	92.32	60
Charter Oak, ...	Sept. 12,	1.055	23	16.22	9.80	60.42	96
Concord, ...	Sept. 13,	1.065	24	15.90	13.16	82.76	102
Concord, ...	Sept. 26,	1.075	24	19.34	15.43	79.78	70.8
Eumalan, ...	Sept. 24,	1.065	16	19.62	13.16	67.07	73
Wild White Grape, ...	Sept. 5,	1.050	·22	15.57	7.20	46.24	140.8
Wild White Grape (shrivelled), .	Sept. 20,	1.060	16	20.02	10.00	49.95	130
Wild Purple Grape (shrivelled), .	Sept. 20,	1.045	16	16.69	8.22	49.25	104

* One part of pure $Na_2\ CO_3$ in 100 parts water.

C. *Analyses of Fruits* — Continued.

[Effect of girdling on grapes.]

NAME AND CONDITION.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter at 100° C.	Glucose in Juice.	Sugar in Dry Matter.	*Soda Sol. required to neutralize 100 parts Juice.
	1877.			Per ct.	Per ct.	Per ct.	C. C.
Hartford Prolific, not girdled,	Sept. 3,	1.045	19	12.85	8.77	68.25	111.4
Hartford Prolific, girdled,	Sept. 3,	1.065	19	17.18	12.50	72.76	100
Wilder, not girdled,	Sept. 3,	1.055	19	15.41	10.42	67.62	108.2
Wilder, girdled,	Sept. 3,	1.075	19	17.24	14.70	85.26	88.4
Delaware, not girdled,	Sept. 4,	1.065	19	15.75	11.76	74.66	101.2
Delaware, girdled,	Sept. 4,	1.075	19	19.14	15.15	79.16	94.4
Agawam, not girdled,	Sept. 4,	1.060	19	16.60	11.37	68.48	128.2
Agawam, girdled,	Sept. 4,	1.075	19	18.45	16.31	87.42	114.8
Iona, not girdled,	Sept. 6,	1.0625	22	16.60	13.51	68.31	131.4
Iona, girdled,	Sept. 6,	1.085	22	21.48	15.63	72.76	125.6
Concord, not girdled,	Sept. 6,	1.045	22	13.46	7.46	55.42	132.4
Concord, girdled,	Sept. 6,	1.070	22	17.53	13.88	79.18	102.8
Concord, not girdled,	Sept. 26,	1.065	22	17.63	13.70	78.27	86
Concord, girdled,	Sept. 26,	1.080	22	24.47	19.61	80.13	76.8
Concord, not girdled,	Oct. 5,	1.075	12	20.92	17.50	85.37	42
Concord, girdled,	Oct. 5,	1.085	12	–	17.86	–	54

	Date.	100 Parts of Grapes contained — Ash.	Moisture.	Glucose.	Tartaric Acid.
	1889.				
Concord, not girdled,	Sept. 23,	–	84.69	6.24	.75
Concord, girdled,	Sept. 23,	.42	83.00	8.13	.85
Concord, not girdled,	Oct. 8,	.53	84.51	6.09	.48
Concord, girdled,	Oct. 8,	.37	82.69	8.50	.50
	1890.				
Concord, not girdled,	Sept. 25,	.47	86.49	7.36	1.15
Concord, girdled,	Sept. 25,	.48	84.93	9.29	1.17
Concord, not girdled,	Oct. 9,	.53	85.39	7.67	.71
Concord, not girdled,	Oct. 9,	.59	85.11	6.65	.51
Concord, girdled,	Oct. 9,	.54	85.15	9.12	.74

* One part of pure Na_2CO_3 in 100 parts water.

C. Analyses of Fruits — Continued.

[Effect of fertilization upon the organic constituents of wild grapes.]

NAME.	Date.	Dry Matter.	Specific Gravity.	Temperature C. (Degrees).	Per Cent. of Glucose.	Per Cent. of Acids.	Remarks.
	1877.						
Wild Purple Grape Berries, .	Sept. 20,	16.31	–	–	8.03	–	Unfertilized.
Wild Purple Grape Berries, .	"	19.55	–	–	13.51	–	Fertilized.
Wild Purple Grape Juice, .	"	–	1.045	16	8.22	9 840	Unfertilized.
Wild Purple Grape Juice, .	"	–	1.065	16	13.51	1.149	Fertilized.
Wild White Grape Berries, .	"	20.02	–	–	–	–	Unfertilized.
Wild White Grape Berries, .	"	21.65	–	–	–	–	Fertilized.
Wild White Grape Juice, .	"	–	1.060	16	10.00	1.846	Unfertilized.
Wild White Grape Juice, .	"	–	–	–	14.29	.923	Fertilized.

[Effect of fertilization upon the ash constituents of grapes.]

NAME.	Date.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Remarks.
	1876.								
Wild Purple Grapes,	Sept. 13,	50.93	.15	22.23	5.59	.79	17.40	2.93	Unfertilized.
Wild Purple Grapes,	Sept. 20,	62.65	.85	14.24	3.92	.53	13.18	4.63	Fertilized.
Concord Grapes, .	July 7,	41.73	5.04	25.03	7.80	.55	18.48	1.37	Unfertilized.
Concord Grapes, .	July 17,	47.34	1.13	24.21	–	.75	21.38	.43	Unfertilized.
Concord Grapes, .	Aug. 18,	51.14	3.19	16.20	6.38	.65	20.77	1.67	Unfertilized.
Concord Grapes, .	Sept. 13,	57.15	4.17	11.30	3.10	.40	12.47	11.82	Unfertilized.
	1878.								
Concord Grapes, .	Oct. 3,	64.65	1.42	9.13	3.63	.50	14.87	5.80	Fertilized.

C. *Analyses of Fruits* — Concluded.

[Ash analyses of fruits and garden crops.]

NAME.	Ash.	100 Parts of Ash contained — Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.
Concord Grape (fruit),	–	51.14	3.19	16.20	6.38	.65	20.77	1.67
Unfermented juice,	–	50.85	.48	3.69	4.25	.10	6.43	.90
Fermented juice,	–	40.69	–	6.85	6.24	–	9.04	–
Skins and pulp,	–	7.70	.42	57.36	8.80	.08	24.40	1.32
Seeds,	3.08	6.71	–	–	3.03	[illegible]	17.20	.29
Stems of grapes,	4.69	20.91	–	20.20	8.45	–	17.75	2.09
Young branches,*	–	24.71	.94	40.53	10.66	1.08	17.16	4.92
Wood of vine,†	2.97	22.57	–	9.72	4.28	–	14.07	23.84
Concord Grapes, 1891,‡	.55	49.76	–	3.50	2.53	1.19	13.56	2.01
Clinton Grape (fruit),	–	58.45	3.51	13.34	7.37	.90	18.19	–
Baldwin Apple,	–	63.54	1.71	7.28	5.52	1.08	20.87	3.68
Strawberry (fruit),§	.52	49.24	3.23	13.47	8.12	1.74	18.50	5.66
Strawberry (fruit),‖	–	58.47	–	14.64	6.12	3.37	17.40	–
Strawberry vines,	3.34	10.62	13.35	36.63	3.83	6.91	14.48	14.17
Cranberry (fruit),	.18	47.96	6.58	18.58	6.78	–	14.27	–
Cranberry vines,	2.45	12.98	3.27	16.49	10.33	3.35	10.94	34.04
Currants, red,	.47	47.68	4.02	18.96	6.23	1.20	21.91	–
Currants, white,	.59	52.79	3.00	17.08	5.68	2.67	18.78	–
Crawford Peach, sound,	–	74.46	–	2.64	6.29	.58	16.02	–
Crawford Peach, diseased,¶	–	71.30	–	4.68	5.49	.46	18.07	–
Branch, sound,	–	26.01	–	54.52	7.58	.52	11.37	–
Branch, diseased,¶	–	15.67	–	64.23	10.28	1.45	8.37	–
Carnation Pinks (whole plant),**	8.80	38.07	12.84	18.64	3.98	.34	5.23	.24
Asparagus stems,	–	42.94	3.58	27.18	12.77	1.22	12.31	.08
Asparagus roots,	–	56.43	5.42	15.48	7.57	–	15.09	3.67
Onions,	–	38.51	1.90	8.20	3.65	.58	15.80	3.33

* With tendrils and blossoms.
† One year old.
‡ Nitrogen in dry matter, .96 per cent.
§ Wilder.
‖ Downing.
¶ Yellows.
** Nitrogen in dry matter, 1.15 per cent.

D. *Analyses of Sugar-producing Plants.*

[Composition of sugar beets raised upon the college grounds during the season of 1870 and 1871.]

NAME.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Sugar.	Non-saccharine Substances.
Electoral, ...	Sept. 10,	14	12.30	1.75
Imperial, ...	" 12,	15	12.59	2.41
Vilmorin, ...	" 13,	14.5	12.95	1.55
Imperial, ...	" 18,	14	10.79	3.21
Imperial, ...	Oct. 11,	15	12.05	2.95
Electoral, ...	" 16,	15	12.22	2.78
Vilmorin, ...	" 18,	16	13.13	2.87
Imperial, ...	Nov. 14,	15	11.60	3.34
Vilmorin, ...	" 21,	15.5	13.12	2.38
Vienna Globe,*	Sept. 19,	11	8.00	3.00
Common Mangold,* . . .	" 19,	9	5.00	3.97

* Fodder beets.

[Percentage of sugar in different varieties of sugar beets grown on college farm during the season of 1882.]

NAME.	Source of Seed.	Weight in Pounds.	Per Cent. of Sugar in Juice.
I. Vilmorin, ...	Saxony, .	¾ to ⅞	15.50
II. Vilmorin, ...	Saxony, .	¾ to 1	15.61
I. White Imperial, ...	Saxony, .	¾ to 1¾	14.20
II. White Imperial, ...	Saxony, .	1¾ to 2	10.27
New Imperial, ...	Saxony, .	1¼ to 1¾	13.80
I. White Magdeburg, . . .	Saxony, .	1½ to 2	13.10
II White Magdeburg, . . .	Silesia,	1½ to 1¾	10.06
Quedlinburg, ...	Saxony, .	1½ to 1¾	13.44
White Silesian, ...	Silesia, .	1¼ to 1½	9.72

D. Analyses of Sugar-producing Plants — Continued.

[Effect of soil and fertilization on Electoral sugar beets.*]

SOIL.	MANURE.	Specific Gravity Brix (Degrees).	Per Cent. of Sugar in Juice.	Non-saccharine Substances.	Cane Sugar in Soluble Matter.
Sandy loam, .	Fresh yard-manure, .	16.5	12.50	4.00	75.08
Clayish loam, .	Fresh yard-manure, .	15.5	11.05	4.45	71.30
Warm alluvial, .	Yard-manure and chemicals, . . .	12.75	9.17	3.58	71.92
Warm alluvial, .	Fresh hog-manure, .	13.5	9.53	3.97	70.06
Light, sandy soil,	No manure, . . .	18.5	13.73	4.77	74.21
Alluvial soil, .	Brighton fish, . .	14.5	11.15	3.35	76.90
Heavy soil, .	Yard-manure, . .	12.25	8.15	4.10	66.53
–	–	13.5	9.90	3.60	73.33

* Not raised on college farm (Connecticut valley).

[Effect of fertilization on sugar beets.*]

FERTILIZERS.	PERCENTAGES OF SUGAR IN JUICE.		
	Freeport.	Electoral.	Vilmorin.
Fresh horse-manure, ...	11.96	9.42	7.80
Blood guano without potash, . .	10.99	10.10	10.20
Blood guano with potash, . . .	12.55	13.24	10.50
Kainite and superphosphate, . .	13.15	12.16	10.50
Sulphate of potash, ...	14.52	14.32	12.78
Second year after stable-manure, .	13.49	12.78	12.19

* All were grown on the same soil, — sandy loam (college).

D. Analyses of Sugar-producing Plants — Continued.

[Effect of different modes of cultivation on Electoral sugar beets.]

Locality of Beet-field.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Cane Sugar.	Non-saccharine Substances.
1. Sing Sing, N. Y.,	1872-73	11	7.80	3.20
2. Washington, N. Y.,	"	14	10.97	3.03
3. South Hartford, N. Y.,	"	15	11.70	3.30
4. Greenwich, N. Y.,	"	12	9.50	2.50
5. Frankfort, N. Y.,	"	13.5	11.00	2.50
6. Albion, N. Y.,*	"	18	15.10	2.90
Albion, N. Y.,†	"	14	9.70	4.30

* From beets weighing from 1½ to 2 pounds. † From beets weighing from 10 to 14 pounds.

1. Soil, loam resting on clayish hard-pan, had been for several years in grass. Tomatoes had been the preceding crop. Five hundred pounds of a phosphatic blood guano were applied before planting.

2. Soil, a clayish loam, had been ploughed seven inches deep. A liberal amount of rotten sheep-manure was placed in trenches and covered by running two furrows together, thus forming a ridge on which the seed were planted.

3. Soil, a gravelly loam, which had been richly manured with stable compost and twice ploughed before planting.

4. Soil, a sandy loam, underlaid by fine sand. The seed were planted on ridges, which covered trenches containing a little rotten stable-manure.

5. No details of modes of cultivation received.

6. Soil, a dark, reddish-brown, rich, deep, sandy loam. Clover had been raised for two years previous to a crop of carrots, which preceded the sugar beets. The beets were the second crop after the application of twenty loads of stable-manure per acre.

Composition of Canada-grown Sugar Beets.

[1872 and 1873.]

Where Grown.	Weight of Roots.	Specific Gravity of Juice (Brix).	Temperature of Juice.	Per Cent. of Cane Sugar in Juice.
Echaullon de Montreal,	2 to 2½ lbs	15.4°	64° F.	11.38
Riviere du Loup,	2 to 3¼ lbs.	14.5°	63° F.	10.20
Chambly,	2 to 2½ lbs.	13.2°	63° F.	9.02
Maskinonge,	2 to 3 lbs.	13.4°	63° F.	8.83

D. Analyses of Sugar-producing Plants — Continued.

[Early Amber Cane.]

DATE.	CONDITION OF CANE.	Brix Saccharometer (Degrees).	Temperature C. (Degrees).	Glucose.	Cane Sugar.	Soda solution required to neutralize 100 parts of Juice.	Solids.
1879.				Per ct.	Per ct.	C. C.	Per ct.
Aug. 15,	No flower stalks in sight,*	4.2	27	2.48	None.	6.8	7.93
Aug. 16,	No flower stalks in sight,*	5.8	24	4.06	None.	9.0	11.10
Aug. 20,	Flower stalks developed,*	7.9	24	3.47	2.15	7.0	13.00
Aug. 24,	Flowers open,*	8.7	23	3.70	3.00	4.0	14.07
Aug. 27,	Plants in full bloom,*	10.0	25	3.65	4.13	10.0	15.48
Aug. 30,	Seed forming,*	9.5	30	4.00	3.81	9.5	16.14
Sept. 2,	Seed in milk,*	10.7	27	3.85	4.41	9.5	15.85
Sept. 9,	Seeds still soft,*	12.1	22	3.21	6.86	9.5	26.13
Sept. 9,	Stripped on Sept. 2,*	12.8	22	3.77	6.81	9.5	26.75
Sept. 18,	Left on field without stripping,*	13.2	22	3.57	7.65	–	–
Sept. 18,	Tops removed,*	13.8	22	3.16	8.49	–	–
Sept. 18,	Tops and leaves removed on Sept. 9,*	11.5	22	3.16	5.85	–	–
Sept. 18,	Tops removed; left on field 9 days,*	12.8	22	10.00	.60	–	–
Sept. 21,	Juice from the above,*	13.0	21	–	–	–	–
Sept. 23,	Juice from the above,*	15.0	18	–	–	–	–
Sept. 25,	Left on field 3 weeks,†	19.8	21	11.91	6.27	–	–
Sept. 28,	Left on field 3 weeks,†	17.8	12	16.60	–	–	–
Oct. 4,	Left on field 3 weeks,†	16.1	17	8.62	6.16	12.0	–
Oct. 7,	Freshly cut. Ground with leaves,†	16.7	20	4.16	9.94	6.8	–
Oct. 8,	Freshly cut. Stripped two weeks,†	12.8	17	5.16	5.27	7.0	–
Oct. 9,	Freshly cut. Stripped two weeks,†	18.4	17	7.57	–	10.6	–
Oct. 14,	Several weeks old,†	18.2	15	10.42	–	10.4	–
Oct. 18,	Several weeks old,†	15.1	23	7.57	–	–	–
Oct. 19,	Several weeks old,†	15.5	15	9.22	–	13.6	–
Oct. 22,	Several weeks old,†	16.2	16	8.30	–	–	–
Oct. 23,	Several weeks old,†	18.3	17	11.30	5.5	14.0	–
Oct. 24,	Several weeks old,†	16.6	15	8.63	–	9.0	–

		100 PARTS OF CANE CONTAINED —				
		Moisture.	Glucose.	Cane Sugar.	Total Sugar.	
1889.						
October,	Early Tennessee sorghum, mature,	77.43	1.79	3.21	5.00	Grown on station grounds.
October,	Price's new hybrid, ripe,	77.80	2.92	3.78	6.70	
October,	Kansas orange, green,	80.67	2.38	3.63	6.01	
October,	New orange, green,	78.30	2.96	3.85	6.81	
October,	Honduras, green,	77.55	3.08	4.01	7.09	

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

D. Analyses of Sugar-producing Plants — Concluded.

[Composition of the juice of corn stalks and melons.]

VARIETY.	Specific Gravity.	Temperature C. (Degrees).	Glucose.	Cane Sugar in Juice.	Solids.
			Per ct.	Per ct.	Per ct.
Northern corn,*	1.023	27	4.35	0.28	15.18
Black Mexican sweet corn,†	1.048	27	2.06	7.02	17.44
Evergreen sweet corn,†	1.052	–	4.85	5.70	20.38
Common sweet corn,‡	1.035	–	6.60	None.	–
Common yellow musk-melon,§	1.040	26	1.67	2.65	–
White-flesh water-melon,	1.025	18	2.91	2.16	–
Red-flesh water-melon,	1.025	22	3.57	2.18	–
Red-flesh water-melon,	1.025	19	3.84	1.77	–
Nutmeg musk-melon,‖	1.030	19	3.33	2.11	–
Nutmeg musk-melon,¶	1.050	20	2.27	5.38	–
Nutmeg musk-melon,**	1.030	19	2.50	1.43	–

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

E. Analyses of Dairy Products.

	Analyses.	Solids.			Fat.			Curd.			Salt.			Ash.
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	
Whole milk,	1,738	18.27	10.58	13.49	7.54	1.72	4.14	-	-	3.20	-	-	-	.70
Skim-milk,	328	10.40	7.68	9.48	1.02	.05	.39	-	-	3.53	-	-	-	.80
Buttermilk,	31	9.86	6.83	8.33	.38	.11	.27	-	-	2.79	-	-	-	.80
Cream (from Cooley Creamer),	176	32.78	19.93	26.47	25.00	13.11	17.98	-	-	-	-	-	-	.62
Butter,	25	92.89	87.05	89.11	89.05	81.43	83.95	.89	.51	.66	6.45	3.46	4.74	-
Whole-milk cheese (Jersey),*	1	-	-	62.84	-	-	37.32	-	-	22.13	-	-	-	3.39
Whole-milk cheese,*	1	-	-	64.17	-	-	34.34	-	-	26.69	-	-	-	3.14
Cheese from milk skimmed after twelve hours' standing,*	1	-	-	62.70	-	-	27.81	-	-	30.37	-	-	-	4.52
Cheese from milk skimmed after twenty-four hours' standing,*	1	-	-	57.78	-	-	23.42	-	-	31.99	-	-	-	2.35
Cheese from milk skimmed after thirty-six hours' standing,*	1	-	-	56.05	-	-	17.67	-	-	33.24	-	-	-	5.14
Cheese from milk skimmed after forty-eight hours' standing,*	1	-	-	54.59	-	-	15.77	-	-	34.94	-	-	-	3.88
Cheese from skim-milk, with addition of buttermilk,*	1	-	-	51.62	-	-	18.35	-	-	28.63	-	-	-	4.64
Genuine oleomargarine cheese,*	1	-	-	62.10	-	-	31.66	-	-	25.94	-	-	-	4.50

* From analyses made in 1875.

E. *Salt for Meat Packing and Dairy Purposes.*

KIND AND SOURCE.	Moisture, 100° C.	Sodium Chloride.	Calcium Sulphate.	Calcium Chloride.	Magnesium Chloride.	Sodium Sulphate.	Magnesium Sulphate.	Insoluble Matter.	Remarks.
Rock salt of Pettite Anse, La.,	.330	98.882	.782	.004	.003	–	–	–	Sent on for examination.
Rock salt of Neyba, San Domingo, W. I.,	.300	98.330	1.480	–	.090	.070	.070	–	
Solar salt, Onondaga, N. Y.,	2.500	96.004	1.315	.092	.089	–	–	–	
Solar salt, Hocking Valley, O.,	2.130	97.512	None.	.234	.089	–	–	–	
Solar salt, Saginaw Valley, Mich.,	3.344	95.813	.316	.356	.140	–	–	–	
Solar salt from Kansas,	4.950	93.060	1.220	–	.240	.350	.180	–	
Solar salt, Lincoln County, Neb.,	1.200	98.130	.250	–	.080	.390	None.	–	
Common fine and boiled salt, Onondaga, N. Y.,	3.000	95.353	1.355	.155	.136	–	–	–	
Common fine and boiled salt, Portsmouth, Mich.,	6.752	90.682	.805	.974	.781	–	–	–	
Common fine and boiled salt, Mason City, O.,	3.470	95.789	–	.614	.041	–	–	–	
Dairy and table salt, Ashton's (English),	0.760	97.652	1.430	–	.060	–	.048	.050	
Onondaga dairy salt,	0.700	97.832	1.263	–	.037	.026	.023	.120	
Fine salt, Bulletin 26, I.,	3.280	95.091	1.487	.032	.075	–	–	.035	
Fine salt, Bulletin 26, II.,	4.591	94.012	1.177	.143	.049	–	–	.028	
Fine salt, Bulletin 26, III.,	4.616	94.236	.999	.071	.026	–	–	.052	Salicylic acid: trace.
Dairy salt, sent on from Amherst, Mass.,	0.145	98.520	1.009	.189	.065	–	–	.072	
Ashton salt (sent on),	.760	97.650	1.430	–	.060	–	.050	.050	
Onondaga factory-filled (sent on),	.600	98.280	.910	–	–	.030	.060	.120	
Dairy salt, sent on from Amherst,	.505	98.202	.877	.168	.046	–	–	.202	
Rock salt from Retsof salt mines,	2.600	95.940	.420	.330	.010	–	–	.700	
Royal salt,	.880	97.877	1.108	.016	.010	–	–	.102	
Excelsior salt,	.320	98.009	1.644	.013	.014	–	–	.020	
Genesee salt,	.295	98.513	1.160	.010	.012	–	–	.010	
Genesee salt,	.235	98.563	1.137	.045	.020	–	–	–	
Bradley salt,	.200	98.575	1.185	.029	.007	–	–	–	
Higgins' Eureka salt,	.855	98.891	.906	.293	.055	–	–	–	
Worcester refined salt,	.565	97.935	1.376	.097	.027	–	–	–	

F. *Analyses of Insecticides.*

	Moisture.	Arsenious Oxide.	Copper Oxide.	Acetic Acid.	Nicotine.	Mercury.	Sulphur.	Sulphuric Acid.	Chlorine.	Calcium Oxide.	Potassium Oxide.	Ferric and Aluminic Oxides.	Insoluble Matter.
Paris green,	1.30	62.55	32.84	3.10	-	-	-	-	-	-	-	-	0.21
Paris green,	1.41	61.40	33.20	3.90	-	-	-	-	-	-	-	-	0.09
Paris green,	1.40	61.15	33.10	3.71	-	-	-	-	-	-	-	-	0.64
Paris green,	1.15	53.91	31.27	8.10	-	-	-	-	-	-	-	-	0.04
Paris green,	1.34	61.25	33.35	3.93	-	-	-	-	-	-	-	-	0.13
Paris green,	1.31	61.21	33.45	3.94	-	-	-	-	-	-	-	-	0.09
Paris green,	1.15	59.92	30.40	-	-	-	-	-	-	-	-	-	0.10
Paris green,	1.27	54.80	30.85	6.50	-	-	-	-	-	-	-	-	0.12
"Sulphatine,"	1.40	-	2.61	-	-	-	48.28	4.73	-	18.60	-	-	1.63
"Death to Rose Bugs,"	2.95	-	1.05	-	-	-	34.53	4.35	-	17.76	-	-	0.49
"Professor De Graff's Carpet Bug Destroyer,"	95.81	-	-	-	-	0.78	-	0.48	0.27	-	0.26	0.90	-
"Oriental Fertilizer and Bug Destroyer,"	87.14	2.38	-	-	-	-	-	.64	3.00	-	3.50	-	-
"Non-poisonous Potato Bug Destroyer,"	-	-	-	-	-	-	-	-	-	68.20	-	1.38	1.50
Tobacco liquor,	37.71	-	-	-	2.12	-	-	-	-	3.07	6.55	0.23	-
Tobacco liquor,	40.89	-	-	-	0.53	-	-	-	-	1.47	16.34	0.01	-
Tobacco liquor,	-	-	-	-	4.55	-	-	-	-	-	-	-	-
Tobacco liquor,	-	-	-	-	4.82	-	-	-	-	-	-	-	-
"Nicotinia,"	10.00	-	-	-	-	-	-	-	-	4.45	9.15	-	2.12
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	2.34
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	88.12
"Peroxide of Silicate,"	1.65	0.57	0.33	-	-	-	-	49.66	-	41.18	-	-	2.31

VI. Tables of the Digestibility of American Feed-Stuffs.

Experiments made in the United States.

Compiled by J. B. LINDSEY.

I. Experiments with Ruminants.

II. Experiments with Swine

Dec. 31, 1893.

TABLE OF THE DIGESTIBILITY OF AMERICAN FEED STUFFS.

I. Experiments with Ruminants.

KIND OF FODDER.	Number of Different Samples.	Number of Experiments.	Number of Animals.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Hay and Dry Coarse Fodders.									
Timothy hay, in bloom,	7	8	13	55.6—65.7 60	56.1—66.8 60	49.6—62.1 56	42.8—75.9 57	40.9—60.4 48.5	58—71.8 65
Timothy hay, past bloom,	4	4	8	47—61.1 53	50.4—62.3 54.5	37.2—56.8 47	54.5—61.1 52	38.8—50.4 45	57.7—67 60
Hay of mixed grasses, poor in nitrogen,	1	1	2	–	–	49	50	40	58
Hay of mixed grasses, rich in nitrogen,*	2	2	7	55.10—62 58	– –	55.90—65.86 60	45.65—57.04 49	56.08—63.76 60	56.80—63.46 60
Clover and timothy hay poorly cured,	1	1	2	54.3—55.3 55	– –	52—54.4 53	– 58	37.5—37.9 38	– 60
Hungarian hay,	1	1	2	64.3—65.8 65	65.9—66.8 66	66.8—68.5 68	– 64	– 60	66.9—67.4 67
Cow-pea-vine hay, fair quality,	1	1	2	– 59	– –	41.2—44.6 43	46.4—53.7 50	63.9—65.1 65	– 71
Clover hay, late bloom, fair quality,	1	1	2	54.4—55.5 55	55.9—56.4 56	43.8—49 46	51.8—54.8 53	49.3—59.1 55	63.3—64.8 64
Clover hay, good quality,	1	2	2	50.8—53.5 52	51.6—54.3 53	46.6—49 48	40—48 43	47—52.2 49	56.8—58.9 58
White clover hay, bloom,	1	1	2	66	67	61	51	73	70
Scarlet clover hay (*T. incarnatum*),	1	1	2	59.4—65 62	– –	42.6—54.8 40	43.7—54 49	68.5—69.7 69	69.3—73.6 72

Alsike clover (*T. hybridum*),	2	2	4	61.1—64.3 62	62—65.2 63	51—58.7 53	35.1—69.3 50	64—69.2 66	66.5—74.1 71
Alfalfa (lucerne), late bloom,	1	1	2	–	–	49	54	77	64
Alfalfa (lucerne), stage not given,	1	1	1	–	–	43	48	69	72
Alfalfa, average both samples,	2	2	3	–	–	46	51	73	68
Hay of blue-joint grass, past bloom,	1	1	2	40	42	37	37	57	43
Hay of blue-joint grass, bloom,	1	1	2	66.7—70.5 69	68.1—71.5 70	71.5—73.4 72	51.4—53.3 52	68.2—72.3 70	66.4—70.9 69
Hay of orchard grass, ten days after bloom,	1	1	2	54	56	58	54	59	54
Hay of orchard grass, stage not given,	1	1	2	57.5—60 59	– –	60—66.7 64	55.4—57.4 56	60—60.8 60	55.3—57.3 56
Average of both samples,	2	2	4	56	56	61	55	60	55
Hay of red top,	2	2	4	57.6—62.3 60	59.3—63.6 61	60.8—61.8 61	44.2—58.8 51	60.4—62.4 61	59.1—65.2 62
Hay of wild oat grass (*Danthonica spicata*),	2	2	3	59.6—68.3 64	61.2—69.1 65	65.1—70.6 68	38.2—62.8 50	48.6—68 58	62.1—68.8 65
Hay of witch grass (*Triticum repens*),	2	2	4	59.9—62.7 61	61—64.3 62	56.4—67.6 62	53.6—60 57	49.5—64.2 58	62.1—69.9 66
Hay of buttercups (*Ranunculus acris*),	1	1	2	56	57	41	70	56	67
Hay of white weed (*Leucanthemum vulgare*),	1	1	2	58	58	46	62	58	67
Soja-bean hay, low in nitrogen,	1	1	2	–	–	58	54	70	82
Dried pasture grass,	1	1	1*	71	–	77	60	72	73
Oat straw,	1	1	2	49—51.7 50	50.8—53.2 52	57.2—58 58	35.5—41 38	– –	51.8—54.6 53

* Above ten per cent. protein.

Table of the Digestibility of American Feed Stuffs — Continued.

KIND OF FODDER.	Number of Different Samples.	Number of Experiments.	Number of Animals.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Hay and Dry Coarse Fodders — Concluded.									
Cotton-seed hulls,	3	3	9	35—47.5 41	– –	0.54—57.6 47	58.2—89.3 79	.00—24.6 6	12.9—45.7 34
Raw cotton seed,	1	2	1	62.9—69.3 66	– –	65—85.9 76	– 87	65.7—70 68	49.2—50 50
Roasted cotton seed,	1	1	2	53.5—58.4 56	– –	62.5—69.3 66	68.5—75 72	44.3—49.6 47	49.8—53 51
Corn stover, whole plant,	1	2	2	61.1—62 62	– –	64.8—68.3 67	48.1—55.8 52	49.6—54.8 52	62.5—64.5 64
Corn stover, tops and blades,	1	1	2	59—60.5 60	– –	71.1—71.7 71	70.6—71.9 71	54.2—56.6 55	61.9—62.6 62
Pulled stover, leaves,	1	1	2	54.8—56.2 56	– –	54.3—67 61	60.6—65.4 63	43.15—68.76 56	57.1—60.65 59
Field corn fodder, ears glazing or glazed,	5	5	10	58.8—71.8 67	– –	53.4—80 70	66.7—79 73	44—64.6 53	61—73.4 68
Field corn fodder, ears glazed, very coarse (sheep),	1	1	2	57.6—63.9 61	– –	66.7—74.3 71	65.6—84.2 75	22.4—35.9 29	59.9—65.5 63
Southern corn fodder, no ears formed,	2	2	4	63.6—70.3 67	65.3—71.4 69	71.7—77.5 74	68.1—72.3 70	57.2—66.1 62	62.8—70.4 67
Corn stalks, below ear,*	1	1	2	64—69 67	– –	71—75 74	79—80 80	15—27 21	65—73 69
Topped stover, part above ear,*	1	1	2	52—58 55	– –	69—72 71	62—65 64	17—27 22	50—57 54

Corn husks,*	1	1	2	71—73 72	- -	78—81 80	23—42 33	24—35 30	75 -
Corn leaves, below ear,*	1	1	2	62—67 65	- -	75—80 78	52—59 56	28—41 35	66—70 68
Green Fodders.									
Corn fodder, quite young,	1	1	2	67.2—70.2 69	- -	73.8—75.6 75	37.5—42.5 40	76.4—79.9 78	64—67.7 66
Dent corn fodder, ears not begun to form, thick seeded,	1	1	2	71.3—73.7 72	- -	70.8—72. 71	76.1—81.6 79	72.5—75.2 74	74.6—75.3 75
Dent corn fodder, ears well formed, thick seeded,	1	2	2	70.9—73.4 72	- -	64.8—68. 66	81.2—83.8 83	56.3—63.7 60	76.7—78.8 78
Dent corn fodder, ears just forming, thin seeded,	1	2	2	67.2—68 68	- -	60—61.4 61	71.6—73.3 73	55.9—56.8 56	74 -
Corn fodder, ears glazing (Burrill & Whitman coarse),	1	1	2	50.88—53.66 52	- -	45.5—46.6 46	74—82 78	20.13—28.14 24	57—61.4 59
Sweet corn fodder, ears in milk,	1	1	2	76.5—78 77	- -	74.2—75.5 75	73.4—74.4 74	77.3—77.6 77	79.6—81.4 81
Sweet corn fodder, ears in milk, partially dry,	2	2	4	60.1—70.2 65	62.4—73.9 68	69.5—76.9 73	66.9—71.3 72	54.6—63.5 61	57.4—72.5 66
Average of three samples,	3	3	6	71	-	74	73	69	73
Early amber sorghum, just after blossom,	1	2	2	60.9—61.7 61	- -	41.7—45.3 42	67 -	37.7—42.5 40	70.4—70.8 71
Sorghum in blossom, variety not stated,	1	1	2	73.1—73.3 73	- -	74—75 75	81.3—81.6 81	51.1—55.7 53	78.2—78.7 78
Average both samples,	2	3	4	67	-	59	74	46	74

* Made at Maryland Experiment Station. It will be noticed that the coefficients of protein digestibility are very much below those obtained in other experiments. The animals were fed but six pounds each per day, with no other food, and it is probable that the metabolic nitrogen products excreted were in a measure at least the cause of the low results obtained.

Table of the Digestibility of American Feed Stuffs — Continued.

KIND OF FODDER.	Number of Different Samples.	Number of Experiments.	Number of Animals.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Green Fodders — Concluded.									
Field corn ensilage, ears glazing,	8	9	16	51.5—69.9 62	62—69.9 65	43—77.8 63	66—90 80	21—57.6 43	52.6—75.6 68
Fine crushed silage (steers),	1	1	2	60.4—68 64	– –	71.6—77.6 75	74.7—76.6 76	32.4—44 38	59.8—69.7 65
Fine crushed silage (sheep),	1	1	2	51.5—56 54	– –	59.5—67.7 64	67.5—69 68	21—22 21.5	52.6—57.3 55
Corn silage, raw, ears mature,	1	1	1	–	–	59	86	45	71
Same, cooked,	1	1	1	–	–	70	87	39	75
Sweet corn ensilage, occasional ears mature,	1	1	2	66.6—69.6 68	68.5—71.7 70	68.4—73.7 71	82.3—84.6 83	52.7—55.2 54	70.7—73 72
Southern corn ensilage, ears not formed,	1	1	2	60.6—65.9 63	63.8—68.7 66	71.4—76.2 74	64.3—66.2 65	42—51.3 47	63.3—67.9 66
Soja-bean ensilage,	1	1	2	52.2—65.8 59	– –	47.1—62.5 55	66.4—77.3 72	71.3—80.2 76	45.9—58.2 52
Green grass, young,	1	1	1	69	–	74	55	65	72
Same, dry,	1	1	1	71	–	77	60	71	73
Pasture grass,	1	1	2	71.9—75.6 74	– –	74.6—76.5 76	74—74.9 74	74—76.5 75	73.8—77.1 75
Average of three samples,	–	–	–	71	–	76	68	70	73
Soiling rye, formation of head,	1	1	2	73.2—74 74	– –	78.9—80.4 80	73.6—74.8 74	78.6—79.7 79	69.7—71.4 71

Soiling clover, late blossom,	1	1	2	64.9—67.3 66	– –	52.3—52.9 53	63—66.1 65	65.8—68.3 67	76.1—79.3 78
Hungarian grass, probably in bloom,	1	1	4	61—67 63	63.4—68.8 66	65.4—71.7 68	47.8—56 52	59.4—66.4 62	63.5—68.4 66
Roots, Tubers, etc.									
Potatoes,	1	1	2	73.3—80.1 77	74.6—81.2 78	– –	13 –	43.4—45.4 44	87.3—93.4 91
Sugar beets,	1	1	2	94.2—94.8 95	97.6—99.9 99	88.5—113 100	46.4—53.5 50	90—92.6 91	99.8—100 100
Mangolds,	1	1	2	77.1—80 79	82.7—87 85	26.8—58.8 43	– –	69.7—79.8 75	90.8—91.9 91
English flat turnips,	1	1	2	90.7—94.9 93	93.2—99 96	89.2—117 100	82.5—92.5 98	84.5—95 90	96—97 97
Ruta-bagas,	1	1	2	84.4—90 87	89.2—93 91	61—87.5 74	76.8—91.6 84.2	74.7—85.9 80.3	94.4—95.1 95
Grains.									
Corn meal, maize,	1	1	2	82.5—86.7 85	– –	– –	87—96.9 92	56.9—59.6 58	85.2—89.1 87
Pea meal,	1	1	2	85.1—88.5 87	86.4—89.5 88	25.5—26 26	52.1—56.9 55	80.5—85.9 83	92.8—94.5 94
By-products.									
Cotton-seed meal,	1	1	2	80.8—82.2 82	80.3—81.8 81	– –	100 –	88.2—89.4 89	67.3—70.4 69
Gluten meal,	1	1	2	84.7—90.2 87	86.3—91.9 89	33 –	85.6—90.1 88	83—90.2 87	88.2—93.5 91
Wheat bran,	4	4	7	54.4—66.45 61	59.5—68.5 63	20—56.28 25	59.5—84.5 72	70.1—82.7 78	58.6—71.22 68

Table of the Digestibility of American Feed Stuffs — Concluded.

KIND OF FODDER.	Number of Different Samples.	Number of Experiments.	Number of Animals.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
By-products — Concluded.									
Wheat middlings,*	1	1	2	72.6—72.2 75	75.1—79.3 77	- -	84.1—86.1 85	78.4—79.4 79	80.7—84.5 83
Wheat middlings,†	1	1	2	79.43—85.63 83	- -	32.57—40.06 36	81.71—87.98 85	81.83—87.75 85	84.43—91.08 88
Malt sprouts,	1	1	1	67	68	34	100	80	69
Buffalo Gluten feed,	1	1	2	75.53—80.44 78	- -	39.92—46.28 43	80.58—82.25 81	83.94—85.97 85	78.44—84.37 81
New-process linseed meal,	1	1	2	79.86—82.60 81	- -	49.24—73.21 61	90.50—91.52 91	86.32—88.16 87	84.71—86.31 86
Old-process linseed meal,	1	1	3	75.48—82.25 79	- -	37.80—71.47 57	85.3 —92.01 89	86.38—93.38 89	75.58—78.73 78
Corn cobs,	1	1	2	58.51—60.43 59	- -	64.50—66.15 65	44.22—56.00 50	12.89—21.88 17	59.71—60.37 60
Dried brewers' grains,	1	1	2	61.63—61.68 62	- -	50.04—55.11 53	89.43—92.79 91	77.71—80.82 79	58.70—58.96 59
Spring wheat bran,	1	1	2	62.26—62.80 63	- -	22.18—25 24	75.53—75.67 76	77.68—81.59 80	69.55—71.22 70
Winter wheat bran,	1	1	1	66	-	56	61	79	70

II. — Experiments with Swine.

Maize kernels, whole,	1	1	1	83	83	38	46	69	89
Maize meal,	2	2	2	89.5—89.7 90	91.3—92.1 92	29.4—48.7 39	77.6—81.7 80	86.1—89.9 88	93.9—94.2 94
Maize meal, with cobs,	1	1	1	76	77	29	82	76	84
Pea meal,	1	1	1	90	92	78	50	89	95
Barley meal,	1	1	1	80	80	49	57	81	87
Wheat shorts,	1	2	2	74—79 77	- -	25—48 37	- -	71—75 73	85.5—88 87
Wheat bran,	1	2	2	53.7—68.6 61	- -	29.6—39.1 34	65.4—78.1 72	74.4—75.8 75	56—75 66

* Jordan.

† Very fine and quite light in color. Lindsey.

Remarks on the Above Tables of Digestibility.

The various reports and bulletins published by the different experiment stations in the United States have been examined, and results of the digestion experiments reported carefully tabulated. It is believed that in many cases these figures can be taken as a very fair representation of the digestibility of American feed stuffs. The writer recognizes the great amount of work done by German investigators in this line, and believes further that in many cases it would not be advisable to repeat this work. It has been suggested, for example, that our climatic conditions being to a considerable degree different from those prevailing in Germany, such influences would cause a considerable difference in the composition and digestibility of many of our fodder articles. It must not be lost sight of, however, that our own country possesses very much wider ranges of climate than are to be found in the entire German empire; and, if climatic influences do cause noticeable variations, then a wider variation would exist between the grass grown in Maine and in North Carolina than between that grown in Hohenheim and Munich. There are, however, many coarse fodder articles and by-products peculiar to the United States which are well worthy of study, and upon which considerable work needs to be done.

It can be stated that in the digestion experiments here tabulated the coarse fodders have with few exceptions been fed alone, while in the case of grains, by-products and roots, the digestibility of hay has first been determined, and then a certain portion of the hay replaced by roots or grains.

LITERATURE.

The following publications have been consulted in compiling the tables of the digestibility of American feed stuffs: —

Reports of the Maine State Experiment Station for 1886, 1887, 1888, 1889, 1890, 1891.

Reports of the New York Experiment Station, 1884, 1888, 1889.

Reports of the Pennsylvania Experiment Station, 1887, 1888, 1889, 1890.

Bulletins 87*d*, 80*c* and 81 of the North Carolina Experiment Station.

Bulletin No. 3 of the Wisconsin Experiment Station for 1884, and Sixth Annual Report, 1889.

Bulletin No. 8 of the Colorado Experiment Station.

Bulletin No. 26 of the Minnesota Experiment Station.

Bulletin No. 6 of the Oregon Experiment Station.

Bulletins Nos. 13, 15 and 19 of the Texas Experiment Station.

Bulletin No. 20 of the Maryland Experiment Station.

Eleventh Annual Report (1893) of the Massachusetts State Experiment Station.

METEOROLOGY.

C. H. JOHNSON.

1893.

The meteorological observations have been continued as in previous years. The temperature, the force and the direction of the wind and the amount of cloudiness are recorded each day, at 7 A.M., 2 P.M. and 9 P.M. During the summer months the reading of a wet-bulb thermometer takes place at the same time. Records are also taken of maximum and minimum temperatures, rainfall, and of casual meteorological phenomena.

Monthly and annual reports are sent to the headquarters of the New England Weather Service at Boston, and during the summer months partial monthly reports have been furnished for the use of the secretary of the State Board of Agriculture.

The most conspicuous meteorological phenomena of the past year (1893) will be briefly considered here, while the following tables will show the average monthly temperature, precipitation, prevailing direction of the wind, etc.

The winter of 1893 was exceptionally cold, the mean temperature of January, February and March being 21.88°.

There was no snow on the ground at the beginning of the year, the first fall worthy of mention occurring on January 10, giving 5.5 inches. The heaviest snowfall of the year was on February 22, amounting to 17 inches. The total amount of snow falling during the season was 71.25 inches. As the weather remained cold, the amount of snow after the first fall did not decrease very much, and the ground was protected until the heavy rains of the 12th and 15th of March.

The mean temperature for January was 14.39°, it being the coldest month since January, 1888, when the mean was 12.5°, as recorded at this station. The mean temperature from the 4th to the 24th of January, 1893, was 8.23°, the absolute minimum temperature during that time being —13°, on the 17th, which was the coldest day of the season. There being no snow on the ground until January 10, the frost penetrated to a depth of 4 feet in places.

The month of February was also characterized by low temperature, the mean being 21.57°, which is about 3° below the average for that month. The total snowfall for the month of February, viz., 48 inches, was much above the average. A storm occurred on the 10th, giving 10 inches, and one on the 22d, giving 17 inches. The latter was accompanied by a heavy wind, which piled the snow in drifts.

The first of March there was snow on the ground to the depth of 15 inches, but heavy rains of the 12th and 15th removed nearly all of it, leaving the ground protected only in sheltered places. There was a thunder-storm the night of March 14.

The mean temperature of April and May was 48.82°, being about 2° below the average. The month of April was unusually cold, with strong north-westerly winds. Seven inches of snow fell during the month, and on the morning of the 26th the surface of the ground was frozen to the depth of 1 inch, the temperature going as low as 25°. Thus, owing to the low temperature of this month, the spring season was backward.

The average mean temperature for June, July and August was 67.38°, being about the normal. The total precipitation amounted to 8.91 inches, being 3.55 inches below the normal.

The rainfall for July, viz., 2.59 inches, was 2 inches below the average.

Thunder-storms were of frequent occurrence during July and August, but were of short duration. The want of rain injured the vegetation in this section.

On the 24th and 29th of August there were rain-storms, accompanied by unusually heavy winds, which did consider-

able damage to crops, blowing much fruit from the trees and injuring many fruit and shade trees.

The mean temperature for September, viz., 55.70°, was 4° below the normal. There was a slight frost on the 3d, which was the first of the season, but there were no damaging frosts during the month. The rainfall was about 1 inch below the normal.

The mean temperature for October was about 3° above the normal, while the rainfall was about the normal.

The mean temperature for November was about the normal, while the precipitation was 1 inch below. There was a slight fall of snow on the 3d, some of the surrounding hills being white.

The mean temperature for December was 24.60°, being 2° lower than that for December of last year. The minimum temperature of the month (—13° F.) came on the 14th. A snow-storm on the 4th, giving about 6 inches, with small additions at intervals, furnished good sleighing during the month.

Summary of Meteorological Observations, 1893.

	Temperature, Degrees Fahrenheit.														
	7 A.M.	2 P.M.	9 P.M.	Mean.	Mean Maximum.	Mean Minimum.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	Greatest Daily Range.	Date.	Least Daily Range.	Date.	Mean Daily Range.
January,	13.39	21.84	14.39	14.48	24.64	4.97	50.00	2d	-13.00	17th	32.00	22d	9.00	5th	19.68
February,	18.25	27.50	22.97	21.57	31.07	12.07	49.00	10th, 15th	-6.00	6th	47.00	6th	3.00	13th	19.00
March,	25.68	36.35	29.81	29.59	38.90	20.29	48.00	14th	3.00	3d	30.00	30th	4.00	11th	18.61
April,	37.50	49.10	41.70	41.90	51.93	31.86	66.00	1st	20.00	3d, 7th	35.00	1st	7.00	15th	20.06
May,	51.90	64.68	54.86	55.74	67.42	44.06	84.00	23d	31.00	8th	43.00	11th	9.00	3d, 27th	23.36
June,	61.90	74.66	64.76	66.53	77.90	55.16	93.00	20th	43.00	2d	38.00	10th	6.00	23d	22.74
July,	63.96	76.64	63.84	67.50	80.26	54.74	90.00	22d	42.00	25th	37.00	21st	11.00	29th	25.52
August,	62.84	77.77	65.55	68.13	80.87	56.00	94.00	10th	40.00	14th	39.00	9th	9.00	20th	24.87
September,	49.80	65.06	54.30	55.71	68.20	43.23	81.00	10th	31.00	27th	40.00	9th	10.00	15th	24.97
October,	52.58	60.68	50.03	51.79	63.71	39.87	79.00	9th	22.00	31st	41.00	17th	8.00	4th	23.84
November,	34.00	44.53	35.40	37.06	46.80	27.33	62.00	2d	10.00	27th	33.00	11th	4.00	29th	19.36
December,	21.40	28.60	25.20	24.60	34.20	15.00	52.00	25th	-13.0	14th	35.0	26th	5.0	29th	19.10
Sums,	493.20	627.41	522.81	534.60	665.90	404.58	-	-	-	-	-	-	-	-	261.11
Mean,	41.10	52.28	43.57	44.55	55.49	33.72	-	-	-	-	-	-	-	-	21.76

Summary of Meteorological Observations, 1893.

January, February, March, April.

	1892.	Date.	1893.	Date.
Mean temperature,	31.43°	-	26.89°	-
Absolute maximum temperature,	76.00°	Apr. 5,	66.00°	Apr. 1.
Absolute minimum temperature,	—10.00°	Jan. 17,	—13.00°	Jan. 17.
Mean monthly range,	18.84°	-	19.34°	-
Total precipitation (inches),	9.74	-	15.53	-
Total snowfall (inches),	34.00	-	71.25	-
Last snowfall (inches),	trace	Apr. 10,	trace	Apr. 21.
Prevailing wind,	N. E. & N. W.	-	N. W.	-

May, June, July, August.

	1892.	Date.	1893.	Date.
Mean temperature,	65.32°	-	64.47°	-
Absolute maximum temperature,	94.50°	June 14,	94.00°	Aug. 10.
Absolute minimum temperature,	30.00°	May 1,	31.00°	May 8.
Mean monthly range,	21.21°	-	24.12°	-
Last frost,	-	May 10,	-	May 8.
Total precipitation (inches),	17.97	-	13.38	-
Prevailing wind,	S. W.	-	N.	-

September, October, November, December.

	1892.	Date.	1893.	Date.
Mean temperature,	43.28°	-	42.29°	-
Absolute maximum temperature,	79.00°	Sept. 18, 19, 25,	81.0°	Sept. 10.
Absolute minimum temperature,	—1.00°	Dec. 27,	—13.0°	Dec. 14.
Mean monthly range,	18.47°	-	21.82°	-
First frost,	-	Sept. 30,	-	Sept. 3.
Total precipitation,	7.50	-	14.31	-
First snowfall (inches),	trace	Nov. 5,	trace	Nov. 4.
Total snowfall (inches),	5.43	-	15.25	-
Prevailing wind,	N. W.	-	N. W.	-

Entire Year.

	1892.	Date.	1893.	Date.
Mean temperature,	45.68°	-	44.55°	-
Total precipitation (inches),	35.21	-	43.22	-
Total snowfall (inches),	39.43	-	86.50	-

Summary of Meteorological Observations, 1893.

1893.	Precipitation, Inches.					Mean Dew Point.				Relative Humidity. Per Cent.				Wind.	Casual Phenomena. — Dates.			
	Total Amount.	Date of Greatest Fall.	Total Snow-fall.	Depth of Snow the 15th.	Depth of Snow at End of Month.	7 A.M.	2 P.M.	9 P.M.	Mean.	7 A.M.	2 P.M.	9 P.M.	Mean.	Prevailing Direction.	Thunder-storms.	Solar Halos.	Lunar Halos.	Aurora.
January,	2.70	1, 2,	13.25	3.00	7.00	–	–	–	–	–	–	–	–	N. W.	– –	18, 31,	29,	–
February,	5.55	22,	48.00	7.00	15.00	–	–	–	–	–	–	–	–	N. W.	– –	11, 12, 28,	1,	5, 15
March,	3.62	11, 12,	3.00	–	–	–	–	–	–	–	–	–	–	N. W.	14,	7, 14, 27,	31,	–
April,	3.66	7, 8,	7.00	–	–	–	–	–	–	–	–	–	–	N. W.	8,	10, 12, 24,	2, 26,	–
May,	4.37	3, 4,	–	–	–	–	–	–	–	–	–	–	–	N. W.	23, 30,	2, 10, 20, 23, 25,	22, 28,	–
June,	2.93	22, 23,	–	–	–	58.70	63.00	59.70	60.46	89.76	69.13	86.10	81.66	N.	4, 6, 11, 30,	7, 14, 16,	–	–
July,	2.59	8,	–	–	–	59.81	63.45	59.71	60.87	87.00	65.09	86.81	79.63	S. W.	1, 3, 5, 8, 10, 12, 17, 18, 22, 25, 26,	22, 25, 28, 30, 31,	28,	–
August,	3.49	29,	–	–	–	59.68	64.54	60.29	61.50	90.68	64.74	80.58	78.63	N.	1, 7, 12, 18, 19, 26, 27,	4, 28,	–	–
September,	2.57	7,	–	–	–	46.97	53.26	49.36	49.86	90.26	63.74	83.40	79.13	S. W.	7,	1, 21, 26,	27,	–
October,	4.45	28,	–	–	–	–	–	–	–	–	–	–	–	S. W.	– –	1, 13,	20, 22,	2,
November,	2.66	28,	–	–	–	–	–	–	–	–	–	–	–	S. W.	– –	7, 8, 9, 21, 23,	23,	3,
December,	4.63	3, 4,	15.25	8.00	4.00	–	–	–	–	–	–	–	–	N. N. W.	– –	–	21,	–
Sums,	43.22	–	86.50	–	–	225.16	244.25	229.06	232.69	357.70	262.70	336.89	319.05	–	– –	–	–	–
Mean,	3.60	–	–	–	–	56.29	61.03	57.26	58.17	89.42	65.67	84.22	79.76	N. W.	– –	–	–	–

ANNUAL REPORT OF C. A. GOESSMANN,

TREASURER OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION

For the Year Ending Dec. 20, 1893.

RECEIVED.

Cash on hand from last year,	$462 67	
Cash from State Treasurer, appropriation,	10,000 00	
Cash from fertilizer account,	2,730 00	
Cash from dairy bureau,	13 00	
Cash from farm,	1,109 45	
		$14,315 12

EXPENDED.

Cash paid salaries,	$4,879 98	
Cash paid laboratory supplies,	356 18	
Cash paid printing and office expenses,	763 41	
Cash paid farmer and farm labor,	2,430 82	
Cash paid farm supplies,	1,778 21	
Cash paid fertilizer account,	2,726 03	
Cash paid construction and repairs,	450 19	
Cash paid expense of Board of Control,	142 91	
Cash paid incidental expenses,	325 99	
Cash paid library,	208 75	
Cash on hand,	252 65	
		$14,315 12

SUMMARY OF THE PROPERTY OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION (DEC. 31, 1893).

Live stock,	$527 00	
Tools, implements and machinery,	978 30	
Produce on hand,	738 59	
Fertilizers,	186 70	
Laboratory inventory,	3,526 27	
Office furniture, library, etc.,	2,138 50	
Furniture, herbariums, library and collections,	1,530 87	
Photographic supplies,	175 00	
Greenhouse apparatus,	117 50	
Mycologists' apparatus,	486 20	
Chemical apparatus and supplies,	326 85	
Buildings, land, etc.,	32,202 00	
		$42,933 78

This is to certify that I have examined the books and accounts of Charles A. Goessmann, Treasurer of the Massachusetts Agricultural Experiment Station, for the fiscal year ending Dec. 20, 1893, and find them correct, and all disbursements properly vouched for, with a balance in the treasury of two hundred and fifty-two and sixty-five one-hundredths dollars, which is shown to be in the bank.

WM. R. SESSIONS,
Auditor.

JAN. 10, 1894.

LIST OF EXCHANGES.

Reports and Bulletins of the United States Department of Agriculture, Washington, D. C.
Reports and Bulletins of the Agricultural Experiment Stations of the United States.
Bulletins of the State Board of Agriculture, Boston, Mass.
The American Cultivator, Boston, Mass.
The Holstein-Friesian Register, Boston, Mass.
Farm-Poultry Monthly, Boston, Mass.
Massachusetts Ploughman, Boston, Mass.
New England Farmer, Boston, Mass.
The Home and Mart, East Boston, Mass.
The American Nation, Boston, Mass.
New England Homestead, Springfield, Mass.
Farm Folks, Springfield, Mass.
Mirror and Farmer, Manchester, N. H.
New York Weekly World, New York, N. Y.
German Agricultural and Horticultural Journal (German), New York, N. Y.
American Agriculturist, New York, N. Y.
The Florists' Exchange, New York, N. Y.
Vick's Magazine, Rochester, N. Y.
The American Analyst, New York, N. Y.
Naturalist Monthly Bulletin, Philadelphia, Pa.
The Practical Farmer, Philadelphia, Pa.
The Farm Journal, Philadelphia, Pa.
The National Stockman and Farmer, Pittsburg, Pa.
Journal of the American Philosophical Society, Philadelphia, Pa.
Contributions from the Botanical Laboratory of the University of Pennsylvania, Philadelphia, Pa.
Veterinary Magazine, Philadelphia, Pa.
Maryland Farmer, Baltimore, Md.
Baltimore Weekly Sun, Baltimore, Md.
Creamery and Dairy, Waterloo, Iowa.
The Agricultural Epitomist, Indianapolis, Ind.
The New Agricultural Era, Indianapolis, Ind.
The Clover Leaf, South Bend, Ind.
The Orange Judd Farmer, Chicago, Ill.
The Western Swineherd, Geneseo, Ill.

The Dairy Messenger, Chicago, Ill.
The Dairy World, Chicago, Ill.
German Agricultural and Horticultural Journal, Chicago, Ill.
Detroit Free Press (weekly), Detroit, Mich.
University Record, Ann Arbor, Mich.
Farmers' Home Weekly, Dayton, Ohio.
American Grange Bulletin, Cincinnati, Ohio.
Journal of the Columbus Horticultural Society, Columbus, Ohio.
The Louisiana Planter, New Orleans, La.
Hoard's Dairyman, Fort Atkinson, Wis.
The Wisconsin Farmer, Madison, Wis.
The Weekly Journal, Sioux City, Iowa.
Hospoda (Bohemian Journal), Omaha, Neb.
The Industrialist, Manhattan, Kan.
The Home and Farm, Louisville, Ky.
The Industrial American, Lexington, Ky.
Journal of the Elisha Mitchell Scientific Society, Chapel Hill, N. C.
Southern Cultivator, Atlanta, Ga.
Monthly Florida Bulletin, Tallahassee, Fla.
West American Scientist, Los Angeles, Cal.
California Cultivator and Poultry Keeper, Los Angeles, Cal.
Journal of the Geographical Society of California, San Francisco, Cal.
Publications of the Department of Agriculture, Quebec, Canada.
The Journal of Agriculture, Montreal, Canada.
Bulletins of the Central Experiment Farm, Ottawa, Canada.
Industrial Journal of Agriculture, Montreal, Canada.
Agricultural Students Gazette, Cirencester, England.
Berichte der Landwirtschaftliche Verssuchstation, Halle, Germany.
Bulletins Ministere de l'Agriculture, Paris, France.
Bulletins of the College of Agriculture, Tokio, Japan.
Bulletins of the Department of Agriculture, New South Wales, Australia.
Agricultural Gazette, New South Wales, Australia.
Bulletins of the Department of Agriculture, Brisbane, Queensland, Australia.
Garden and Field Journal, South Australia.
Journal of the Council of Agriculture, Hobart, Tasmania.
Relatorio Annual da Estacao Agronomica de Campinas, Sao Paulo, Brazil.
Ragguagli, Laboratorio Chimico Agrario di Bologna, Bologna, Italy.
Reglamento, etc., Estacion Agronomica del Instituto Agricolo de Alfonso XII., Madrid, Spain.

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TO ELEVENTH ANNUAL REPORT, 1893.